ADDITIONAL SITE CHARACTERIZATION ACTIVITIES REPORT

Baldwin Hardware Site
841 East Wyomissing Boulevard
Reading, Pennsylvania

Prepared For:
MASCO Corporation

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TABLE OF CONTENTS

Page

1.0 INTRODUCTION AND PURPOSE....1

2.0 BACKGROUND....2
2.1 REGULATORY HISTORY....2
2.2 PREVIOUS INVESTIGATIONS....2
2.2.1 CRA INVESTIGATIONS, 1999-2000....2
2.2.2 LEA INVESTIGATION, 2004....3
2.2.3 LEA INVESTIGATION, 2005....3

3.0 SCOPE OF WORK....5
3.1 PRE-INVESTIGATION ACTIVITIES....5
3.2 DRILLING AND PIEZOMETER CONSTRUCTION ACTIVITIES....6
3.2.1 PIEZOMETER INSTALLATION....6
3.2.2 PIEZOMETER DEVELOPMENT ACTIVITIES....8
3.2.3 SURVEYING ACTIVITIES....8
3.2.4 DISPOSAL CHARACTERIZATION....8
3.3 PIEZOMETER SAMPLING ACTIVITIES....9
3.4 HYDRAULIC MONITORING....9
3.4.1 SITE-WIDE WATER LEVELS (SYNOPTIC)....9
3.4.2 SINGLE WELL HYDRUALIC TESTING....10
3.4.3 CONTINUOUS WATER LEVEL MONITORING (TRANSDUCERS)....10
3.4.4 CONDITIONS THAT AFFECTED CONTINUOUS WATER LEVEL MEASUREMENTS....11

4.0 HYDROGEOLOGIC EVALUATION OF 2007 SITE DATA....12
4.1 GEOLOGIC CONDITIONS....12
4.2 GROUNDWATER FLOW CONDITIONS....13
4.2.1 LATERAL FLOW....13
4.2.2 VERTICAL FLOW....13
4.3 CONTINUOUS MONITORING PROGRAM RESULTS....14

5.0 SITE CONCEPTUAL MODEL....18

6.0 CONCLUSIONS....20

LIST OF FIGURES
(Following Report)

FIGURE 1.1	SITE LOCATION
FIGURE 1.2	SITE PLAN
FIGURE 4.1	CROSS-SECTION PLAN VIEW
FIGURE 4.2	GEOLOGIC CROSS-SECTION (A-A')
FIGURE 4.3	GEOLOGIC CROSS-SECTION (B-B')
FIGURE 4.4	GEOLOGIC CROSS-SECTION (C-C')
FIGURE 4.5	GEOLOGIC CROSS-SECTION (D-D')
FIGURE 4.6	GROUNDWATER ELEVATIONS - JUNE 19, 2007
FIGURE 4.7	GROUNDWATER ELEVATIONS - JUNE 28, 2007
FIGURE 4.8	GROUNDWATER CONTOUR MAP - JUNE 28, 2007
FIGURE 4.9	HYDROGEOLOGIC PROFILE (A-A')
FIGURE 4.10	HYDROGEOLOGIC PROFILE (B-B')
FIGURE 4.11	HYDROGEOLOGIC PROFILE (C-C')
FIGURE 4.12	HYDROGEOLOGIC PROFILE (D-D')
FIGURE 4.13	TRANSDUCER DATA FOR MONITORING LOCATIONS, SCHUYLKILL RIVER AND PRECIPITATION - JULY 3 TO JULY 31, 2007
FIGURE 4.14	TRANSDUCER DATA FOR SELECT WELLS DURING SYSTEM SHUTDOWN - JULY 5 AND 6, 2007
FIGURE 4.15	TRANSDUCER DATA FOR PZ-40S, PZ-80I, AND PRECIPITATION - JULY 5 AND 6, 2007
FIGURE 4.16	TRANSDUCER DATA FOR PZ-40S, MW-08, MW-07S, PZ-80S, AND MW-06 - JULY 27 TO 31, 2007

LIST OF TABLES
(Following Figures)

TABLE 3.1	MONITORING WELL AND PIEZOMETER CONSTRUCTION DETAILS
TABLE 3.2	GROUNDWATER ELEVATIONS

LIST OF APPENDICES

APPENDIX A	BOREHOLE AND WELL CONSTRUCTION LOGS
APPENDIX B	PHOTOGRAPHIC DOCUMENTATION OF SPLIT-SPOON SAMPLES
APPENDIX C	WELL DEVELOPMENT FIELD DATA SHEETS
APPENDIX D	DISPOSAL CHARACTERIZATION LABORATORY REPORT
APPENDIX E	TRANSDUCER DATA (ELECTRONIC FILES ON CD)
APPENDIX F	STREAMFLOW AND PRECIPITATION DATA
APPENDIX G	SINGLE WELL HYDRAULIC TEST DATA
APPENDIX H	GEOTECHNICAL LABORATORY REPORT

1.0 INTRODUCTION AND PURPOSE

This Report presents the findings of additional characterization activities completed by Conestoga-Rovers & Associates (CRA), on behalf of MASCO Corporation (MASCO), at the Baldwin Hardware Corporation (Baldwin) facility at 841 East Wyomissing Boulevard in Reading, Pennsylvania (Site). The additional characterization activities were completed in accordance with a scope of work letter dated June 20, 2007. The scope of work considered previous discussions at a July 27, 2006 meeting between MASCO, CRA and Black & Decker (current Site owner) and their consultant Loureiro Engineering Associates, Inc. (LEA). Figure 1.1 provides a Site location map. A Site plan is presented as Figure 1.2.

This Report describes the results of additional characterization activities conducted at the Site from May through August 2007. Specifically, this report evaluates the three-dimensional flow and the ability of the volatile organic compounds (VOCs) to migrate in groundwater away from the established and documented capture zone of pumping.

Since 1988, Baldwin has complied with an Administrative Order on Consent (AOC) requiring them to pump-and-treat groundwater beneath the Site that is contaminated with trichloroethene (TCE). The AOC requires that a three-dimensional capture zone be established through pumping to prevent the migration of contaminants in the groundwater to other properties. These contaminants comprise primarily VOCs. During 2006, all parties agreed that the pump-and-treat system was effectively capturing groundwater in the bedrock beneath the Site. The additional characterization activities focused on a hydraulic investigation along the southeast property boundary of the Site, specifically downgradient of monitoring well MW-06. Elevated concentrations of TCE above the Safe Drinking Water Act Maximum Contaminant Level (MCL) of 5 micrograms per liter (μg/L) have been detected in groundwater samples collected at MW-06 in 2004 and 2005. The primary objective of the additional characterization activities is to confirm that contaminated groundwater within the overburden and bedrock in the area near MW-06 does not migrate off the Site.

2.0 BACKGROUND

This section presents an overview of the regulatory history and previous investigations completed at the Site.

2.1 REGULATORY HISTORY

On April 13, 1987, Baldwin (a subsidiary of MASCO) and Region III of the United States Environmental Protection Agency (EPA) entered into an Administrative Order on Consent (AOC) requiring Baldwin to install and operate a groundwater pump-and-treat system at the Site to remediate volatile organic compounds (VOCs) detected in groundwater. The AOC established a cleanup goal for TCE in groundwater beneath the Site of 5 μg/L based on the MCL for TCE. The AOC also provided that wells at the Site be pumped at a combined rate of 300 gallons per minute (gpm) to maintain a groundwater capture zone beneath the Site. Typical pumping rates for the production wells are as follows: PS-1 = 15 gpm; PW-4 = 37 gpm; PW-5 = 255 gpm. Baldwin has complied with the AOC from 1988, when pump-and-treat operations began, to the present. During 2006, all parties agreed that the pump-and-treat system was effectively capturing groundwater in the bedrock beneath the Site.

2.2 PREVIOUS INVESTIGATIONS

This section presents an overview of the previous investigations completed at the Site.

2.2.1 CRA INVESTIGATIONS, 1999-2000

During the period of 1999-2000, CRA on behalf of MASCO performed an evaluation of the existing groundwater pump-and-treat system that had been in operation for over 10 years at the Site (*CRA, Groundwater Pump-and-Treat System Evaluation Report, 2000*). The study concluded that the pump-and-treat system was effectively capturing groundwater at the Site and, therefore Baldwin was in conformance with the technical requirements of the AOC. During the study, CRA also completed a soil-boring program in the vicinity of well PW-5. Results of the soil-boring program indicated that there were no active sources of VOCs near PW-5.

2.2.2 LEA INVESTIGATION, 2004

On October 1, 2003, MASCO sold the property to B&D. LEA on behalf of B&D conducted soil sampling, well installation, and groundwater sampling activities in 2004. The 2004 investigation results were documented in a letter dated January 11, 2005. Based on a review of the results, the following observations are made by CRA:

- Elevated concentrations of VOCs are present in the soil (zero to 20 feet below grade) in the vicinity of pumping well PW-5 and in the area between this well and pumping well PW-4.
- Groundwater was observed in piezometer PZ-40S, which was previously dry during all other dates measured.
- The groundwater is impacted by VOCs at well MW-06, which is screened from 73 to 78 feet below grade within a clay starting at 59 feet below grade.
- Concentrations of VOCs measured in groundwater samples from the other overburden wells at or near the property boundary (MW-05S, -07S, and -08S) and wells located off the Site (MW-2, MW-3, MW-6, P-1, P-3S, P-3I, and P-3D) are non-detect, below water quality standards, and/or qualified by the laboratory.
- The aquifer pumping test completed on September 10 and 11, 2004 document a water level response in the wells monitored.

Based on the above results and communication between MASCO, CRA, B&D, and LEA, it was determined that additional groundwater sampling activities should be performed. LEA prepared a scope of work dated August 12, 2005 to specifically address these data gaps.

2.2.3 LEA INVESTIGATION, 2005

LEA conducted additional groundwater sampling activities in 2005. Specifically, LEA performed well re-development in select wells, a round of water level measurements on November 27, 2005, and a groundwater sampling event from November 28 through December 1, 2005. These activities are summarized in an LEA letter dated March 22, 2006. Based on a review of the results, the following observations are made by CRA:

Monitoring well MW-06 could not be adequately re-developed because of the limited volume of water and yield in this well.

The November 27th groundwater elevation data are typical of pumping conditions at the Site. The cone of influence (capture zone) created by the drawdown encompasses the areas where VOCs were detected above MCLs. Of note, was that piezometer PZ-40S was dry.

TCE and its daughter products were detected in the 2005 groundwater samples at locations and concentrations consistent with historical groundwater data. A review of the 2005 analytical results indicates that a number of compounds were detected at levels that exceed their respective MCL; however, all exceedances were within the AOC-required groundwater capture zone created by the pumped wells. The compounds detected above applicable MCLs include: TCE, 1,1,1-Trichloroethane (TCA), 1,1-Dichloroethane (1,1-DCA), 1,1-Dichloroethene (1,1-DCE), and cis-1,2-Dichloroethene (cis-1,2-DCE). Maximum concentrations of TCA, 1,1-DCA, and cis-1,2-DCE were detected in piezometer PZ-40S. A maximum TCE concentration of 1,800 µg/L was detected in monitoring well MW-06. Similar to the 2004 analytical results, concentrations of VOCs found in the other overburden wells at or near the property boundary (MW-05S, -07S, and -08S) and wells located off the Site (P-1, P-3S, P-3I, and P-3D) are non-detect, below water quality standards, and/or qualified by the laboratory.

3.0 SCOPE OF WORK

The primary objective of the additional characterization activities was to confirm that contaminated groundwater within the overburden and bedrock in the area near MW-06 does not migrate off the Site. This section documents the hydraulic data collected in order to evaluate the three-dimensional nature of groundwater flow. This evaluation of capture will provide confirmation that capture is occurring or, if not, what proactive measures need to be taken.

The following field activities were completed in May and June 2007 at the Site:

- Installation of four additional piezometers along the southeast boundary of the Site;
- Collection of geotechnical samples during piezometer installation;
- Well development activities at the newly installed piezometers;
- Collection of two synoptic rounds of groundwater levels from all wells and piezometers onsite;
- Slug testing of piezometers;
- Oversight of groundwater sampling activities by LEA personnel;
- Performance of long-term hydraulic monitoring of current conditions at select monitoring locations;

The following sections describe in more detail the additional characterization activities performed to meet the objectives discussed above.

3.1 PRE-INVESTIGATION ACTIVITIES

In November 2006, James Stewart, Inc. surveyed and staked the southeast property boundary. The purpose of the survey was to ensure that the proposed piezometers would be installed on Baldwin property.

Prior to the start of additional characterization activities, clearing of vegetation and overgrowth was required for access to the proposed work locations. On May 25, 2007, Earth Care performed landscaping activities along the southeast property boundary. A path of access was cleared from the property fence just east of MW-07D north along the railroad tracks to a location immediately downgradient (southeast) of MW-06.

3.2 DRILLING AND PIEZOMETER CONSTRUCTION ACTIVITIES

The following sections present a summary of the drilling and piezometer construction activities. The purpose of these piezometers was to provide groundwater level data at various depths along the southeast boundary of the Baldwin property.

3.2.1 PIEZOMETER INSTALLATION

Table 3.1 summarizes construction information regarding the existing wells and the newly installed piezometers, which include:

PZ-80I (intermediate bedrock (I) piezometer)
PZ-80S (shallow bedrock (S) piezometer)
PZ-80WB (weathered bedrock (WB) piezometer)
PZ-90WB (weathered bedrock (WB) piezometer)

For purposes of this investigation, the following definitions apply:

Overburden = soil above the weathered bedrock zone comprised predominantly of silt and clay.
Weathered bedrock = rock beneath the overburden and above competent bedrock comprised predominantly of weathered limestone.
Competent bedrock = rock beneath the weathered bedrock comprised predominantly of limestone and some shale.

In May and June 2007, the four new piezometers were installed to further characterize the geology and hydraulics along the southeast property boundary in order to confirm capture. Eichelbergers, Inc. of Mechanicsburg, Pennsylvania conducted the drilling activities under the oversight of CRA. The newly installed piezometers along with the existing well network are shown on Figure 1.2.

The PZ-80 cluster of piezometers (PZ-80I, PZ-80S, and PZ-80WB) were installed directly downgradient of MW-06 at the toe of the slope along the property boundary. The topographic relief between MW-06 and the PZ-80 cluster is approximately 20 feet over a lateral distance of approximately 30 feet. PZ-90WB was installed approximately 70 feet west of existing well MW-07S. The piezometer was not installed immediately adjacent to MW-07S (per the scope of work) due to access restrictions.

Piezometers PZ-80WB and PZ-90WB were completed in the weathered bedrock to the top of competent rock. There was no water observed in the overburden or the weathered rock during the drilling program. Although dry conditions were observed, the piezometers were installed to serve as data points going forward. Furthermore, a review of the lithologic data acquired during the drilling program and a review of the well logs reveals that MW-06 is not an overburden well.

Additional piezometers (PZ-90S and PZ-90I) were planned for installation downgradient of piezometer PZ-40S. However, Baldwin would not permit drilling into bedrock at the proposed location due to previous drilling issues encountered at MW-07D. Specifically, during drilling of MW-07D, there was an apparent hydraulic connection between MW-07D and pumping well PW-5. The drilling created an increase in suspended solids within the PW-5 well.

Bedrock piezometers were drilled using the air rotary drilling method. Six-inch diameter outer steel casing was permanently installed 2 to 5 feet into rock prior to advancing the drill bit. Weathered bedrock piezometers were installed via hollow-stem auger drilling method. Split-spoon samples were collected during hollow-stem auger drilling to characterize subsurface lithology. The piezometers were constructed with 2-inch inside diameter Schedule 40 PVC riser and 0.01-inch slot PVC screen. A filter sand pack was installed in the annulus adjacent to the screen to a minimum of two feet above the top of the screen. A bentonite pellet seal was installed above the filter pack, and hydrated with potable water. A stickup, locking compression cap, and surficial concrete pad were installed for the monitoring well.

Detailed boring logs and well construction information are provided in Appendix A. During drilling of the piezometers, CRA collected grab soil samples for screening with a photoionization detector (PID). The PID responses are presented on the boring logs in Appendix A. No PID responses above background were observed during drilling activities. In addition, photographs of split-spoon samples were taken. The borehole designation and sample interval depth were recorded on a card and shown in each photograph. The photographic documentation is included in Appendix B.

Grab soil samples were collected at PZ-80WB and PZ-90WB for geotechnical analysis. The soil samples were submitted to Valley Forge Laboratories, Inc. of Wayne, Pennsylvania for geotechnical analysis. The analysis consisted of particle size analysis via sieve and hydrometer testing in accordance with ASTM Standard D422.

No soil samples were submitted for laboratory environmental analysis by CRA. However, LEA personnel collected soil samples from PZ-80WB and PZ-90WB for submittal to a laboratory for VOC analysis. CRA has not received or reviewed analytical results from soil samples collected by LEA.

3.2.2 PIEZOMETER DEVELOPMENT ACTIVITIES

On June 13, 2007, Eichelbergers, Inc. completed piezometer development of the newly installed piezometers. There was an insufficient water column in piezometer PZ-90WB to allow for proper development and PZ-80WB was dry. Piezometers PZ-80S and PZ-80I were developed using a submersible pump until the piezometer was purged dry or field parameters stabilized and the water was visually clear of sediment. Approximately 40 gallons (10 standing well volumes) were purged from PZ-80S. Piezometer PZ-80I was purged dry twice; approximately 42 gallons (2.6 standing well volumes) were removed. Well development field data sheets are included in Appendix C.

3.2.3 SURVEYING ACTIVITIES

On June 25, 2007, Wilkinson & Associates, Inc. surveyed the locations and elevations of the newly installed piezometers relative to mean sea level. The top of the piezometer casings were surveyed to the nearest 0.01 feet, and a survey point was marked on each casing. Ground elevation at the wells and piezometers was surveyed to the nearest 0.10 feet. The horizontal location (northing, easting) of the wells and piezometers was surveyed to the nearest 1.0 feet.

3.2.4 DISPOSAL CHARACTERIZATION

Development water and drill cuttings were temporarily placed in 55-gallon drums and staged onsite. On June 27, 2007, CRA collected disposal characterization samples from the soil cuttings generated during the drilling activities. On July 16, 2007, CRA collected disposal characterization samples from the development water generated during sampling. CRA submitted the samples to Lancaster Laboratories, Inc. for analysis of the required disposal characterization parameters [TCLP VOCs and Metals (soil) and Total VOCs and RCRA Metals (water)]. CRA forwarded the analytical results upon receipt to Mr. David Hancock of Baldwin. As agreed upon between MASCO and Black & Decker, Baldwin is responsible for coordinating the manifesting, transport, and proper disposal of the investigative-derived waste. The laboratory analytical reports are included in Appendix ~~D~~. E.

3.3 PIEZOMETER SAMPLING ACTIVITIES

The collection of analytical data is not part of the additional characterization activities, as only hydraulic data was required for the analysis. However, at the request of B&D, LEA attempted to sample the newly installed piezometers. On June 20, 2007, LEA collected groundwater samples from piezometers PZ-80S and PZ-80I. The two weathered bedrock piezometers (PZ-80WB and PZ-90WB) could not be sampled because they were dry. CRA conducted oversight during the sampling event, but did not collect any split samples. To date, CRA has not received any groundwater analytical results or field data sheets for the sampling event.

3.4 HYDRAULIC MONITORING

This section presents the activities completed with regard to hydraulic monitoring during May through July 2007. The monitoring included both synoptic water level measurement events and continuous water level monitoring in select wells/piezometers. In addition, single well response tests were conducted at two of the four newly installed piezometers.

3.4.1 SITE-WIDE WATER LEVELS (SYNOPTIC)

Two synoptic rounds of depth-to-water measurements were obtained by CRA from the monitoring well and piezometer network at the Site. The first round of groundwater levels was collected by CRA on June 19, 2007. The second round was collected on June 28, 2007. The depth-to-water measurements and the corresponding groundwater elevations are presented on Table 3.2. The purpose of these water level measurements were to provide a "snapshot" of groundwater elevations at the Site and to confirm the accuracy of transducer measurements. Depth-to-water measurements were not obtained from OW-3D and PZ-30S on June 19, 2007 due to well lock issues. The locks were removed (replaced with new ones) and depth-to-water measurements obtained on June 28, 2007. A depth-to-water measurement could not be collected from piezometer PZ-70I on June 28, 2007 due to a vehicle parked atop the well. Depth-to-water measurements could not be collected from the four pumping wells and MW-07D during either round because they were inaccessible.

3.4.2 SINGLE WELL HYDRUALIC TESTING

On June 29, 2007, CRA performed single well hydraulic testing (slug methods) on PZ-80S and PZ-80I.[1] Rising head and falling head slug tests were completed at piezometer PZ-80S. A falling head slug test was completed at piezometer PZ-80I.

Slug injection and removal was performed in order to calculate an estimate of the hydraulic conductivity within the saturated zone of the piezometer. Each slug test was performed through the instantaneous introduction of a solid PVC slug into the well and recording both the time (elapsed) and the displacement rise (slug in) and subsequent fall (slug out) of the water level. The slug tests performed by CRA were analyzed using the Bouwer and Rice (1976) method for unconfined aquifers with partially or fully penetrating wells.

3.4.3 CONTINUOUS WATER LEVEL MONITORING (TRANSDUCERS)

CRA monitored groundwater levels in the newly installed piezometers and select monitoring wells and piezometers from July 3 through July 31, 2007. The hydraulic monitoring program consisted of obtaining hydraulic data under equilibrium (pumping) conditions and transient conditions during the shutdown (inadvertent) of the groundwater pump-and-treat system. To measure and record groundwater level data, electronic transducers were placed in the following eight monitoring locations:

- MW-06
- MW-07S
- MW-08
- PZ-40S
- PZ-80WB
- PZ-80S
- PZ-80I
- PZ-90WB

The transducers were programmed to record data at a minimum every 15 minutes during the hydraulic monitoring program. The transducers recorded pressure (pounds per square inch) as feet of water above the transducer. For each monitoring point, the

[1] Two piezometers, PZ-80WB and PZ-90WB, were dry or had an insufficient water column to perform these tests.

data were correlated with the measured depth-to-water level and converted to a corresponding elevation mean sea level. A barometric transducer was placed into piezometer PZ-30I (well above the water level) to collect barometric pressure data. The barometric data were subsequently used to compensate groundwater level data recorded from the other eight transducers. Depth-to-water measurements were taken in the eight monitoring locations on June 29, 2007 prior to insertion of the transducers and during interim downloading of transducer data on July 3, 12, and 31, 2007. Appendix ~~E~~ F presents the transducer data in electronic form.

3.4.4 CONDITIONS THAT AFFECTED CONTINUOUS WATER LEVEL MEASUREMENTS

During the continuous hydraulic monitoring program, local precipitation and streamflow data were obtained. Precipitation data from the Spring Township (Sinking Spring) station were obtained from the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center (NCDC). Several minor and one significant rainfall event occurred during the hydraulic monitoring period. Streamflow data were obtained from the Schuylkill River at the U.S. Geological Survey's Reading, Pennsylvania station (USGS# 01471510). The station is located 0.85 miles north-northeast of the Site approximately 200 feet south of the Penn Street Bridge. Precipitation and streamflow data are included as Appendix F. Precipitation events occurred on July 4, 5, 10, 11, 16, 18, 19, 23, 27, and 29, 2007. Three of these rain events totaled more than 0.50 inches each (July 5, 27 and 29).

In addition, during the continuous hydraulic monitoring program, the groundwater pump-and-treat system operated continuously at an approximate combined pumping rate of 300 gpm. Two inadvertent pump-and-treat system shutdowns occurred on July 6 and 27, 2007. Baldwin personnel estimated that the system shutdown on the morning of July 6, 2007 lasted for approximately 25 minutes. Baldwin personnel confirmed that a second system shutdown occurred the evening of July 27, 2007 for about 3 hours.

4.0 HYDROGEOLOGIC EVALUATION OF 2007 SITE DATA

This section presents an evaluation of the data collected during the additional characterization activities completed in 2007. The focus of this evaluation was to define the three-dimensional nature of groundwater flow along the property boundary and to confirm that contaminated groundwater within the overburden and bedrock in the area near MW-06 does not migrate off the Site.

4.1 GEOLOGIC CONDITIONS

The logs from the recently installed piezometers were used to update CRA's Site Conceptual Model (SCM) of geologic conditions. The new logs provided information that was, for the most part, consistent with past description of geology.

Geologic cross-sections lines are depicted in plan view on Figure 4.1. Geologic cross-sections (A-A', B-B', C-C' and D-D') are presented on Figures 4.2 through 4.5. The piezometers and monitoring wells used in the development of the cross-sections are identified in each section and shown with depicted screen intervals (or as open bedrock). Monitoring wells and piezometers are projected onto the sections where noted.

The cross-sections indicate that the Site is underlain by overburden, weathered bedrock, and competent bedrock based on drilling logs and Site information. The overburden consists primarily of silt and clay with some sand zones. It ranges in thickness from 15 feet to 40 feet. The weathered bedrock consists of weathered limestone and sandstone. Its thickness is highly variable and ranges from 25 feet to nearly 60 feet. Competent rock, consisting of limestone, and dolomite, is present beneath the weathered zone. The carbonate bedrock is interbedded with shale and sandstone sequences. Solution cavities and sinkholes are known to occur in the vicinity of the Site.

The cross-sections and logs indicate that the overburden (soil) is less thick than described in the previous conceptual model and reports by LEA. As a consequence, a few wells are not completed in the units previously identified. For example, MW-06 is completed in a clay-filled void in weathered bedrock, not in overburden as previously believed.

4.2 GROUNDWATER FLOW CONDITIONS

4.2.1 LATERAL FLOW

Depth-to-groundwater was measured in monitoring wells and piezometers at the Site on June 19 and June 28, 2007. During the synoptic events, existing recovery wells PS-1, PS-2, PW-4, and PW-5 were pumping. The depth-to-water measurements and the corresponding groundwater elevation data are provided in Table 3.2. The groundwater elevation data indicate that all of the wells and piezometers measured, with the exception of OW-1 (greater than 3 feet), showed no significant change (less than 1 foot) between the two synoptic groundwater level events. The groundwater elevation data for the June 19 and 28, 2007 synoptic events are depicted on Figures 4.6 and 4.7, respectively. Figure 4.8 presents a groundwater contour map for wells/piezometers that are completed at open intervals between 150 and 200 feet mean sea level.

The water table is artificially lowered to an approximate elevation of 175 feet mean sea level in the center of the Site due to the continuous pumping of the recovery wells at a combined rate of approximately 300 gpm. Groundwater flow in the bedrock is primarily in the intermediate bedrock zone with radial inward flow toward the pumping wells. This includes capture of shallow groundwater along the southeast property boundary, which under non-pumping conditions would continue to flow to the southeast. This is consistent with the previous conceptual model presented in the 2000 report by CRA.

4.2.2 VERTICAL FLOW

The nature of the vertical groundwater flow within the bedrock was also assessed during these studies. Hydraulic data were evaluated using contouring techniques and are depicted on hydrogeologic profiles (A-A′, B-B′, C-C′, and D-D′). The June 28, 2007 groundwater elevations were utilized in the analyses. Hydrogeologic profiles are depicted in plan view on Figure 4.1. Groundwater elevations are presented in boxes at the middle of the screened or open interval for each piezometer/well. Sections A-A′, B-B′, C-C′ and D-D′ are presented on Figures 4.9 through 4.12.

Section A-A′ depicts downward vertical movement of water from the overburden and weathered bedrock to the deeper competent bedrock. The horizontal flow component indicates groundwater flow is from the property boundary to the interior of the Site where pumping is being performed.

Section B-B′ depicts downward vertical movement of water from the overburden and weathered bedrock to the deeper competent bedrock. Pumping well PW-5 significantly influences groundwater flow from the downgradient MW-07 well cluster along the southeast property boundary.

Section C-C′ depicts vertical movement of water from the overburden and weathered bedrock to the deeper competent bedrock. There is also an upward vertical flow component within the deeper bedrock (e.g. from PZ-20 well cluster to the MW-05 well cluster) up to the pumping wells.

Section D-D′ depicts downward vertical movement of water from the overburden and weathered bedrock to the deeper competent bedrock in the northeast portion of the Site. Pumping well PW-5 significantly influences groundwater flow in the competent bedrock and captures groundwater in bedrock from the southwest well cluster PZ-60 and the PZ-20 well cluster in the northeast portion of the Site. There is an upward vertical flow component within the deeper bedrock (e.g. from PZ-60 well cluster to the PZ-05 well cluster).

This is consistent with the previous conceptual model presented in the 2000 report.

4.3 CONTINUOUS MONITORING PROGRAM RESULTS

The continuous hydraulic monitoring program was completed from July 3 to July 31, 2007. The groundwater elevation data are depicted on Figures 4.13 through 4.16.

Figure 4.13 presents an overview of all of the transducer data collected from July 3rd through July 31st. The figure also includes local precipitation and Schuylkill River data. Precipitation events are shown on the graph to occur on July 4, 5, 10, 11, 16, 18, 19, 23, 27, and 29. Three of these rain events totaled more than 0.50 inches each (July 5, 27 and 29). As apparent from this graph, inadvertent system shutdowns occurred on July 6 and 27, 2007. Baldwin personnel estimated that the system shutdown on the morning of July 6, 2007 lasted for approximately 25 minutes. Baldwin personnel confirmed that a second system shutdown occurred the evening of July 27, 2007 for about 3 hours. The groundwater elevation in PZ-90WB dropped below the transducer elevation (set approximately 3 feet above bottom [~189.9 mean sea level]). During the first synoptic round of groundwater levels on June 19, 2007, well PZ-90WB was confirmed dry with the use of a depth-to-water probe.

Figure 4.14 presents the transducer data for select wells monitored along with the precipitation data for the time period of July 5th through 6th. This hydrograph indicate a slight increase (on the order of ½-foot) in the groundwater elevation in these wells after a significant rain event on July 5th (over 1 inch of rain in 1 hour). The total rain for July 5th was 3.23 inches. Although no official shutdown of the pumping system occurred, the system inadvertently shutdown due to a mechanical failure (e-mail correspondence from Dave Hancock, July 19, 2007) on the morning of July 6th for approximately ½-hour. Well MW-07 and PZ-80S show a significant response (~ 2-foot rise in groundwater elevation) during the time the system was off. Likewise, these wells show a decline in groundwater elevation when the system came back online. Monitoring wells MW-06 and MW-08 also show a response (~ 0.2 to 0.4 feet rise in groundwater elevation) during the time the system was off. These data, along with the relative groundwater elevation of these wells (~175 to 180 feet mean sea level), confirm that these wells are influenced by the bedrock pumping system and confirm lateral and vertical capture along the southeast property boundary, including at the MW-06 area.

Piezometer PZ-40S, which is the closest well to pumping well PW-5, did not respond to the system shutdown on July 6th (see Figure 4.13). Based on the lack of response to the system shutdown, the water in piezometer PZ-40S is isolated and temporary water that slowly moves vertically downward due to gravity to the water table. This water is not part of the continuous lateral groundwater flow system. The water table elevation in the vicinity of piezometer PZ-40S and PW-5 is simply below the bottom of piezometer PZ-40S (elevation 176.20 feet mean sea level) because PW-5 has depressed the water table in this area to below 175 feet mean sea level. Under non-pumping conditions, the water table elevation in PZ-40S and PW-5 would be on the order of 185 to 195 feet mean sea level.

Figure 4.15 presents the transducer data for piezometer PZ-40S, piezometer PZ-80I, and precipitation data. As shown on this graph, piezometer PZ-40S responds immediately to the rain events recorded on July 5th as surface water infiltrated through holes in the cap required to hang the transducer. Piezometer PZ-80I responds slower (and not as significantly) with a lag accounting for the precipitation to infiltrate into the ground. Other monitoring well responses to this rain event (see Figure 4.13) were similar to PZ-80I. Based on these observations, the fact that PZ-40S is a flush mount well, and its location in a low area in a parking lot, piezometer PZ-40S is highly susceptible to direct surface water infiltration. As piezometer PZ-40S is a 1-inch piezometer, a small amount of surface water runoff getting into the piezometer will cause a significant increase in the water elevation (1-foot increase per 0.08 gallons of water). Also apparent from Figure 4.15 is that PZ-40S does not respond to natural infiltration similar to the other monitoring wells. Piezometer PZ-40S is not in the water table when PW-5 is pumping.

Regardless, this water eventually migrates vertically downward and is captured by the bedrock pumping system.

During the field activities, we noted that the flush mount for PZ-40S has been compromised (i.e., the concrete pad and flush mount move). Unfortunately, we necessarily had to drill a hole into the cap to temporally install the transducer. We will replace this cap at the end of the transducer monitoring program. We were unaware at that time that the flush mount seal was not adequate. We recommend that the flush mount at PZ-40S be repaired or that this well be turned into a stickup protective casing.

Figure 4.16 presents the transducer data for MW-06, MW-07S, MW-08, PZ-40S, and PZ-80S for the time period of July 27TH through July 31st. This hydrograph shows a rapid and significant increase (on the order of 2 to 5 feet) in the groundwater elevation in these wells after an inadvertent system shutdown on the evening of July 27th for 3 hours (e-mail correspondence from Dave Hancock, August 7, 2007). Likewise, these wells show a decline in groundwater elevation when the system came back online. PZ-40S showed a negligible response to the shutdown.

In summary, the data presented in this section are consistent with the previous conceptual model presented in the 2000 report. Infiltration from precipitation moves vertically downward to the water table. Once at the water table, groundwater flows radially inward toward the bedrock pumping wells where it is captured. This includes groundwater along the southeast property boundary.

4.4 AQUIFER CHARACTERIZATION

Single Well Hydraulic Test Results

Monitoring wells PZ-80S and PZ-80I are completed in the shallow and intermediate bedrock, respectively. The field data, graphic plots, and single well hydraulic test software calculations are included as Appendix G. The estimated hydraulic conductivities of the bedrock ranged from 0.06 to 0.31 feet per day. The average of the two falling head tests is 0.19 feet per day. The test results are consistent with hydraulic conductivity values published for the Buffalo Springs Formation (DCNR, 2002).

As noted in Section 3, single well hydraulic tests could not be completed at wells PZ-80WB and PZ-90WB, because they were dry.

Geotechnical Results

Four soil samples were submitted to Valley Forge Laboratories, Inc. of Wayne, Pennsylvania for geotechnical analysis. The analysis consisted of particle size analysis via sieve and hydrometer testing in accordance with ASTM Standard D422. The results of the analysis indicated the soil classification as provided in the table below. The soil laboratory test report is included in Appendix H. The data are consistent with low permeability material.

Sample Identification	Sample Interval (feet bgs)	Sample Description / Unified Soil Classification
PZ-80WB	20 -25	Silt with Sand (ml)
PZ-80WB	33 - 34	Sandy Silt (ml)
PZ-90WB	8 - 10	Sandy Silt (ml)
PZ-90WB	20 - 22	Silt with Sand (ml)

5.0 SITE CONCEPTUAL MODEL

This section presents a Site Conceptual Model (SCM) based on historical and recently acquired data. An initial SCM was provided in the CRA March 2000 *"Groundwater Pump-and-Treat System Evaluation Report"*. The revised SCM focuses on the southeast portion of the Site where the recent investigative activities were completed.

The Site is located on a hill sloping from north to south resulting in surface drainage from north-northwest to south-southeast. Once reaching a topographic low on the south side of the Site, overland flow is then to the east-southeast toward the Schuylkill River, which is approximately 1,000 feet east of the Site.

The geology beneath the Site is divided into three separate zones, the overburden, weathered bedrock, and competent bedrock. The thickness of overburden material varies from 15 to 40 feet and consists predominantly of silt and clay. The underlying layer of weathered bedrock ranges from 25 to 60 feet. The bedrock consists of carbonate rocks, primarily limestone and dolomite of the Buffalo Springs Formation. The competent bedrock is hundreds of feet thick.

The geologic units also form distinct hydrogeologic units beneath the Site. However, due to the limited thickness of the overburden soils and weathered bedrock and groundwater pumping at the Site, these two units are typically dry. In addition, these two units have relatively low permeabilities, and therefore have limited ability to store and transmit water. Groundwater in this zone is isolated and temporary, and is not in a continuous lateral groundwater flow zone. Rather, these zones slowly transmit recharge vertically downward to the underlying more permeable bedrock fracture zones. The overburden in the center of the Site (between pumping wells PW-4 and PW-5) has been impacted with TCE contamination. TCE and its associated daughter products migrated vertically downward through the overburden and into the weathered bedrock and to the water table.

The water table is found in the carbonate bedrock, which is composed of minerals that are soluble in rainwater. As precipitation seeps into the rock and moves through secondary openings, it has dissolved the soluble minerals of the rock and widened the openings into solution cavities, which are ideal for storing and transmitting groundwater. The fractures and solution openings in the shallow bedrock (150 to 200 feet mean sea level) beneath the Site appear to be filled, at least partially, with silt and clay, which have reduced the ability of these fractures to transmit water. However, the fractures and solution openings in the deeper bedrock (< 150 feet mean sea level) are more well developed, which enables them to transmit significant quantities of water.

The present pump-and-treat system is capturing and controlling groundwater at the Site, including groundwater containing dissolved TCE. Continual pumping of the groundwater pump-and-treat system at a rate of approximately 300 gpm has resulted in groundwater flow toward the center of the Site. The equilibrium (pumping) groundwater elevation in the center of the plume is on the order of 175 feet mean sea level. This is approximately 20 feet of drawdown from the natural conditions measured when no pumping was occurring.

Along the southeast property boundary, TCE has been detected in well MW-06. Piezometers installed in the shallow and intermediate bedrock (PZ-80S and PZ-80I) along the southeast property boundary have hydraulic head values greater than MW-06 indicating flow toward the interior of the Site to the pumping wells; not toward the southeast property boundary. Furthermore, all piezometers and wells along the southeast property boundary, including MW-06, respond to pumping as evidenced during two inadvertent system shutdowns in the summer of 2007. Concentrations of TCE found in the other overburden wells at or near the property boundary (MW-05S, -07S, and -08S) and wells located off the Site (MW-2, MW-3, MW-6, P-1, P-3S, P-3I, and P-3D) are non-detect, below water quality standards, and/or qualified by the laboratory. The pumping of the wells captures all groundwater within the bedrock and overburden along the southeast property boundary.

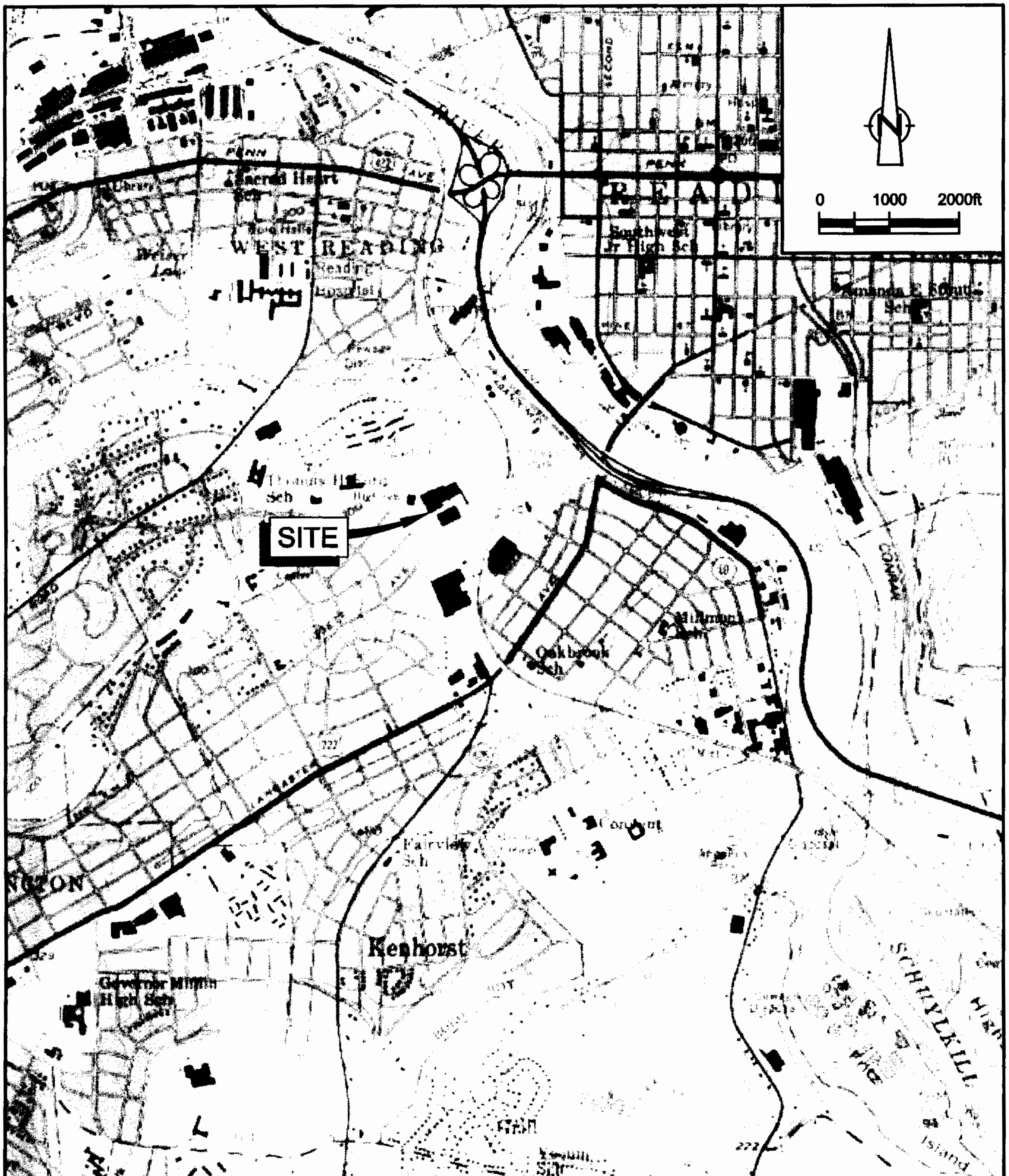
6.0 CONCLUSIONS

The purpose of this study was to define three-dimensional flow and to confirm that VOC-contaminated groundwater within the overburden and bedrock along the southeast property boundary (near MW-06) does not migrate off the Site. Based on historical information, the data collected during this study and the evaluation of the data presented herein, the following conclusions are drawn:

- The overburden (soil) along the southeast property boundary is less thick than originally believed. The overburden material above the bedrock varies from approximately 15 to 40 feet thick and consists predominantly of silt and clay. The weathered bedrock, which underlies the overburden and overlays the competent bedrock, ranges from approximately 25 to 60 feet thick.
- Some wells/piezometers previously believed to be completed in overburden and/or weathered bedrock are actually completed in weathered bedrock and/or competent bedrock (e.g., MW-06).
- Only temporary water exists in the overburden and weathered bedrock; therefore, no continuous lateral groundwater flow occurs in these units. The overburden and weathered bedrock are dry; on occasion, minimal water (a few inches to a few feet) may exist after precipitation events. This water percolates vertically downward to the water table surface.
- Continual pumping at the Site has resulted in an equilibrium groundwater elevation (water table) in the center of the plume at an approximate elevation of 175 feet mean sea level, which is in the bedrock. Groundwater flow in the bedrock is toward the center of the Site, where continual pumping at approximately 300 gpm is ongoing.

In conclusion, this study confirms that groundwater along the southeast property boundary is captured by the groundwater pump-and-treat system. The groundwater pump-and-treat system effectively captures all groundwater at the Site.

TCE and other VOCs are present in the overburden unsaturated (soil) in the center the Site. Dissolution of TCE during times of higher groundwater elevation may occur after precipitation events as water infiltrates the subsurface. TCE migrates vertically downward with the infiltrating water to the water table where it is then captured by the groundwater pump-and-treat system. TCE and its daughter compounds were non-detect, below MCLs, and/or qualified by the laboratory (with the exception of MW-06) along the southeast property and off the Site. All groundwater along the southeast property boundary is captured including TCE detected at well MW-06. Baldwin is in conformance with the technical requirements of the AOC.



SOURCE: USGS QUADRANGLE MAPS;
READING, PENNSYLVANIA

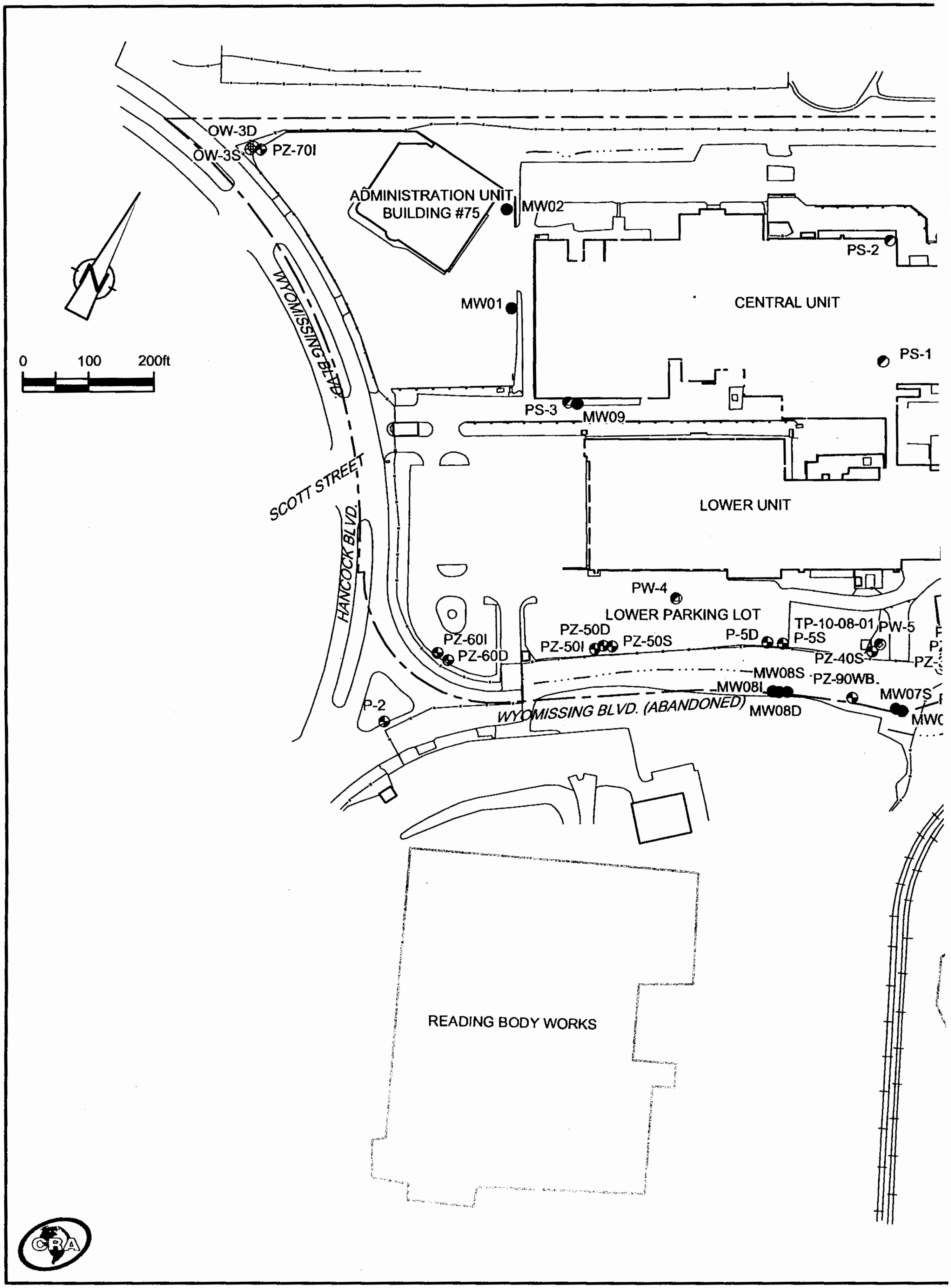
READING
PENNSYLVANIA

CRA

figure 1.1

SITE LOCATION
BALDWIN HARDWARE CORPORATION
Reading, Pennsylvania

13706-00(002)GN-WA001 SEP 29/1999



13706-00(005)GN-WA001 SEP 21/2007

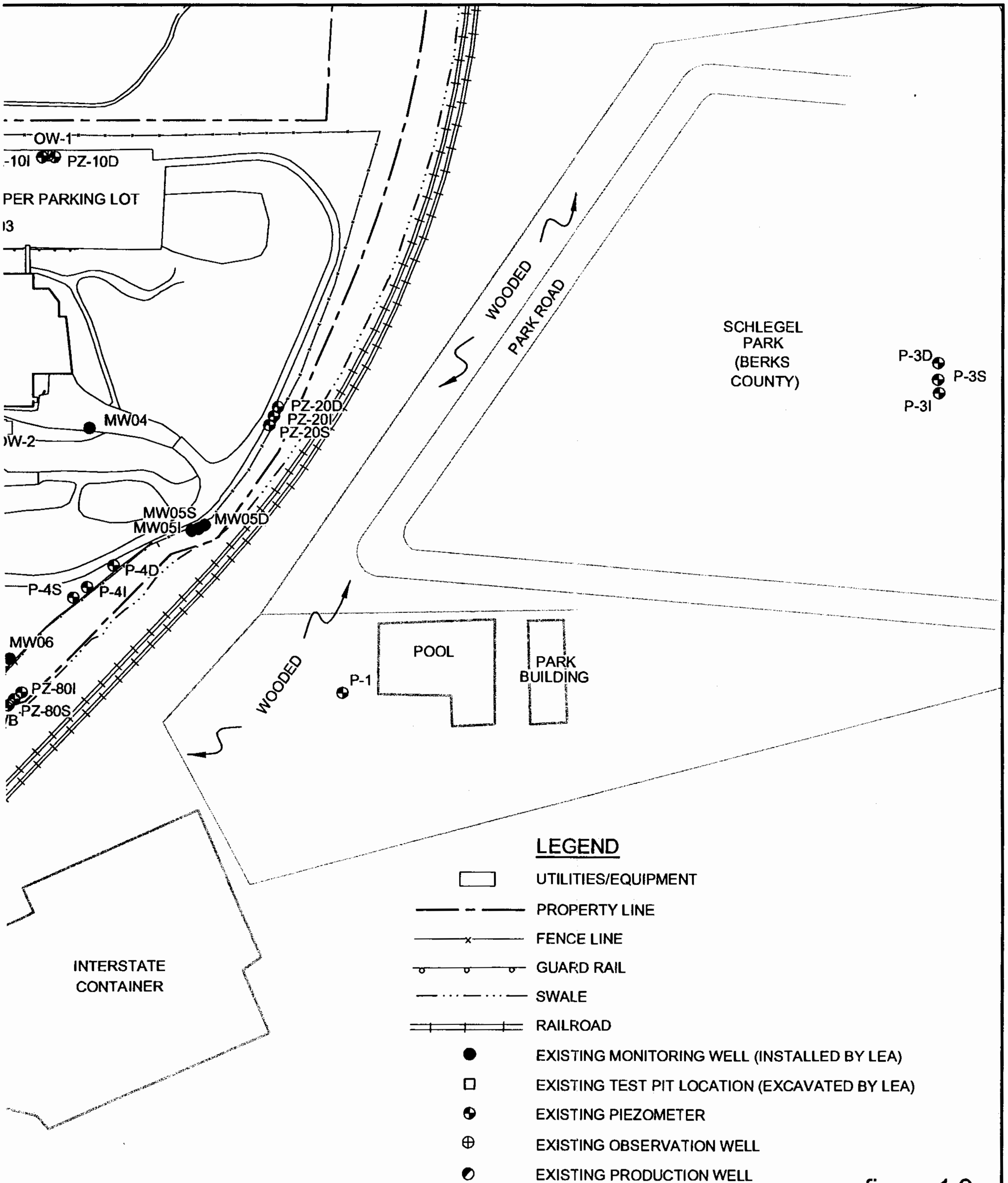
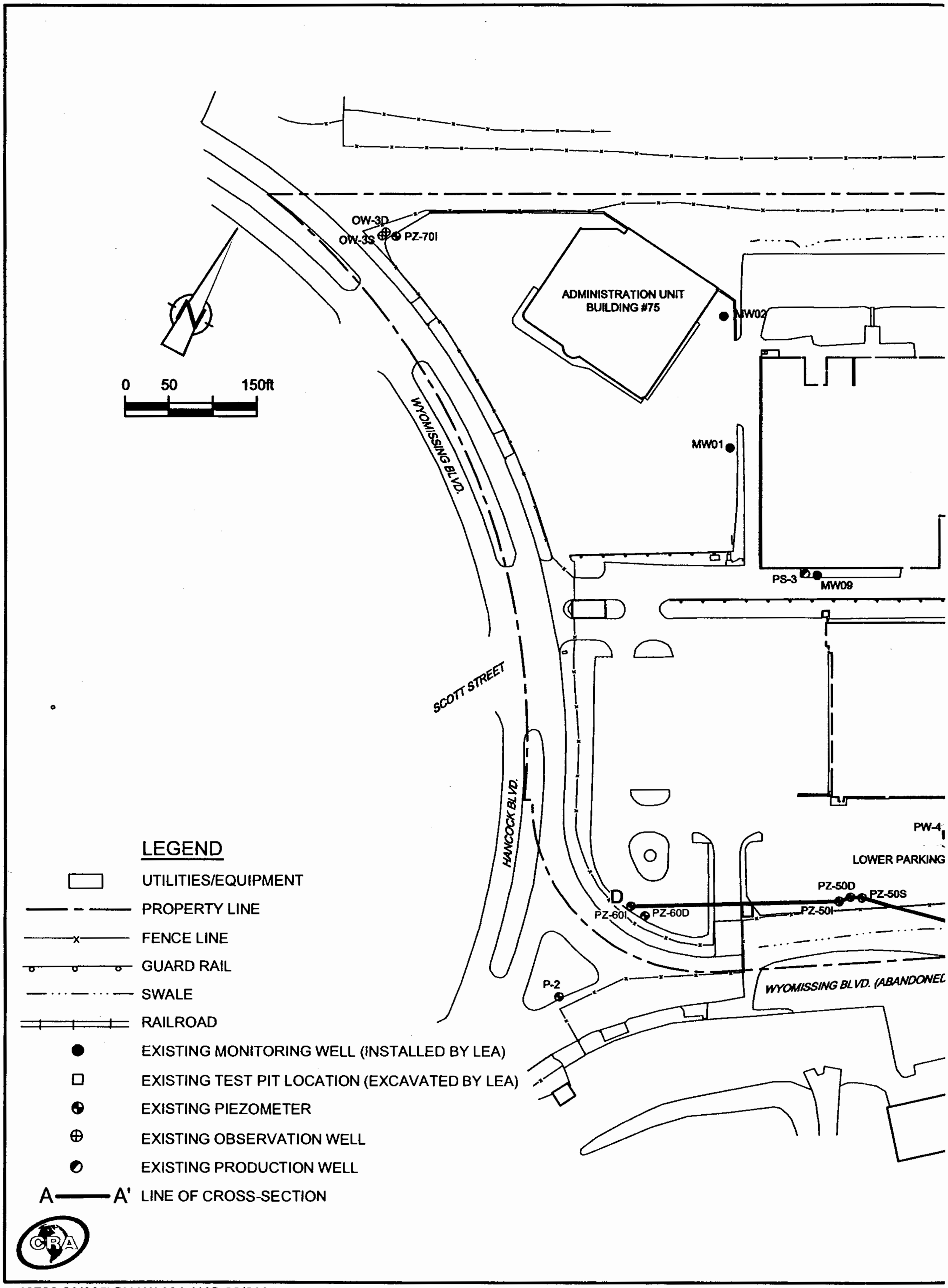


figure 1.2

SITE PLAN
BALDWIN HARDWARE CORPORATION
Reading, Pennsylvania



13706-00(005)GN-WA004 AUG 20/2007

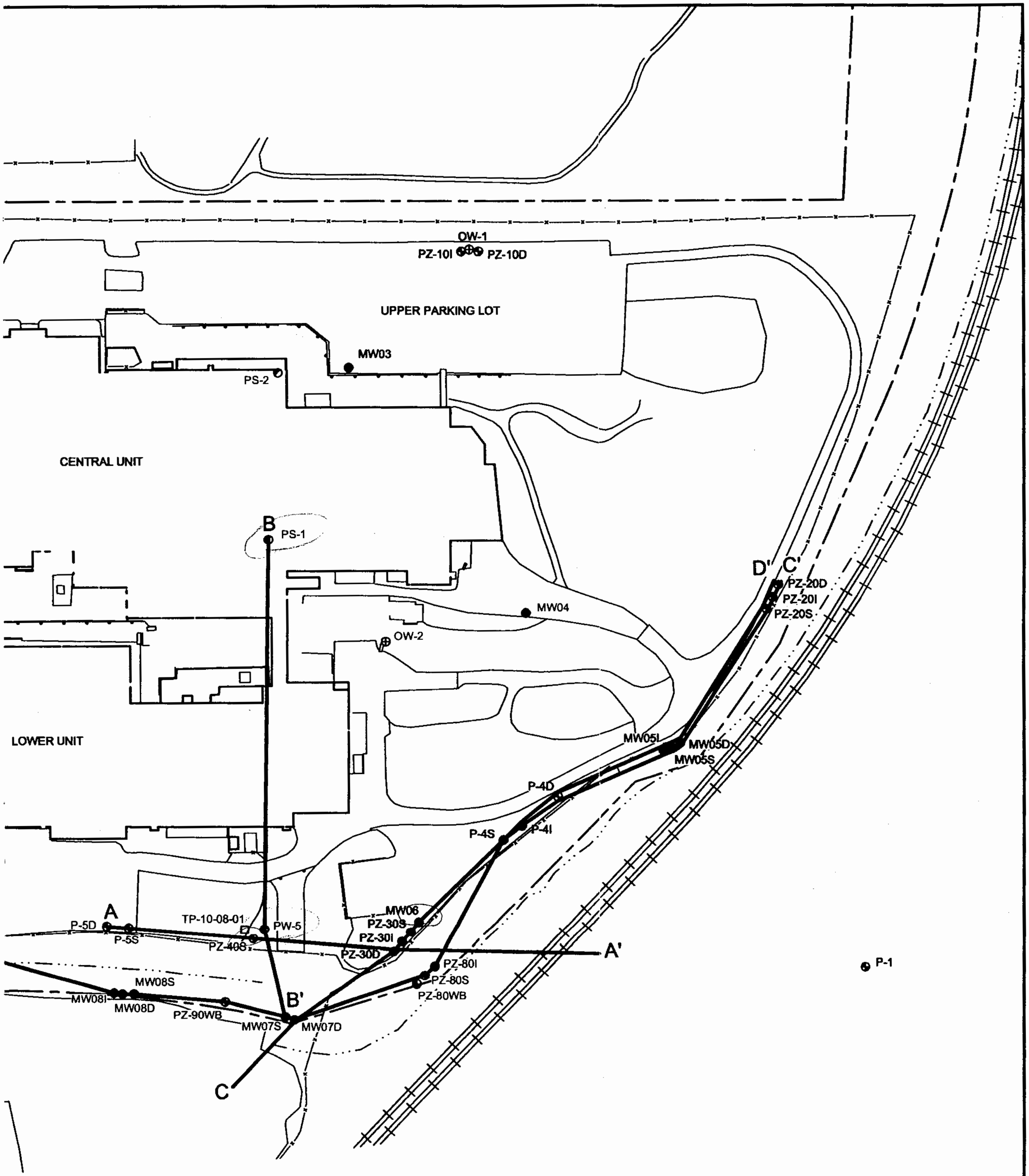


figure 4.1

CROSS-SECTION PLAN VIEW
BALDWIN HARDWARE CORPORATION
Reading, Pennsylvania

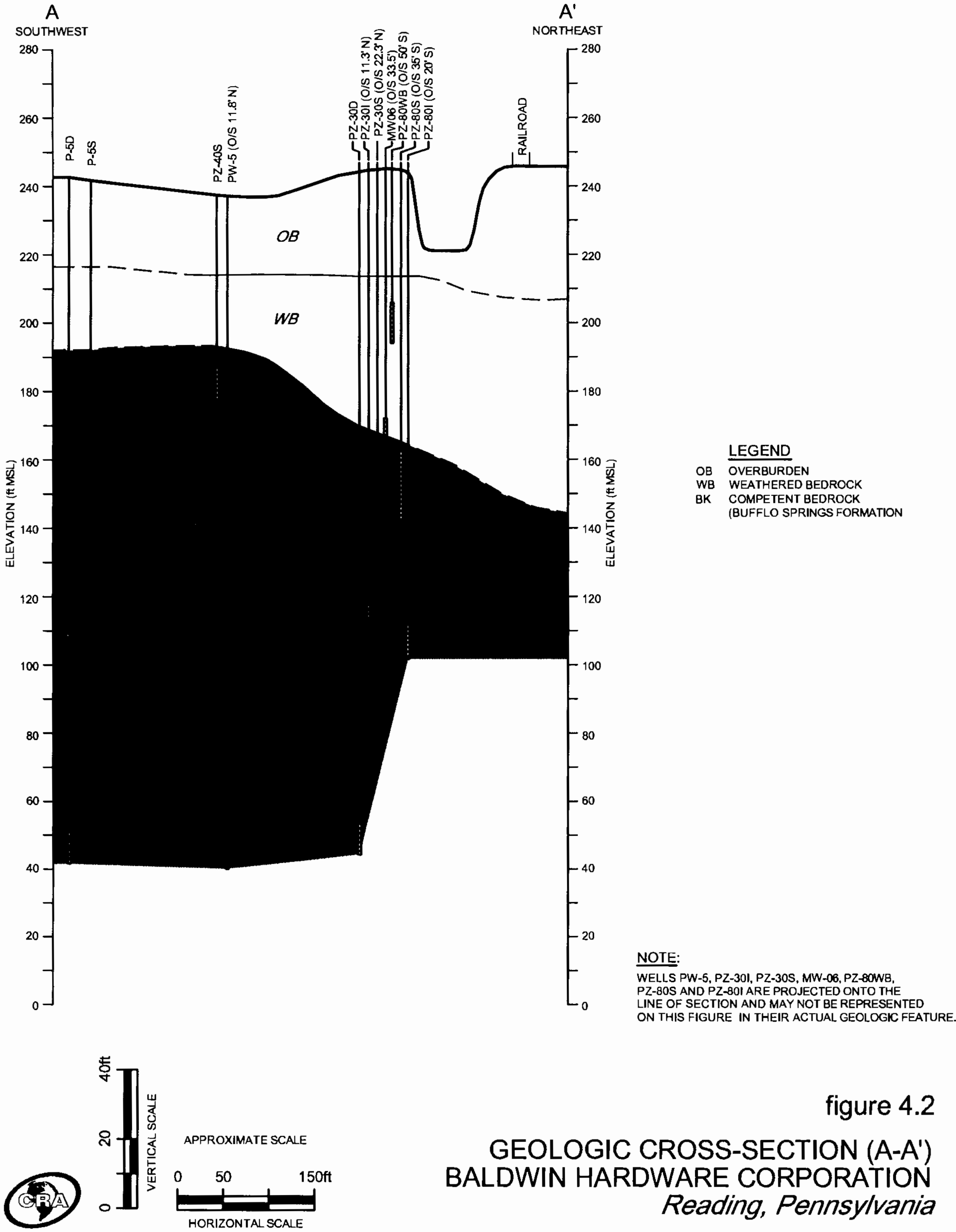
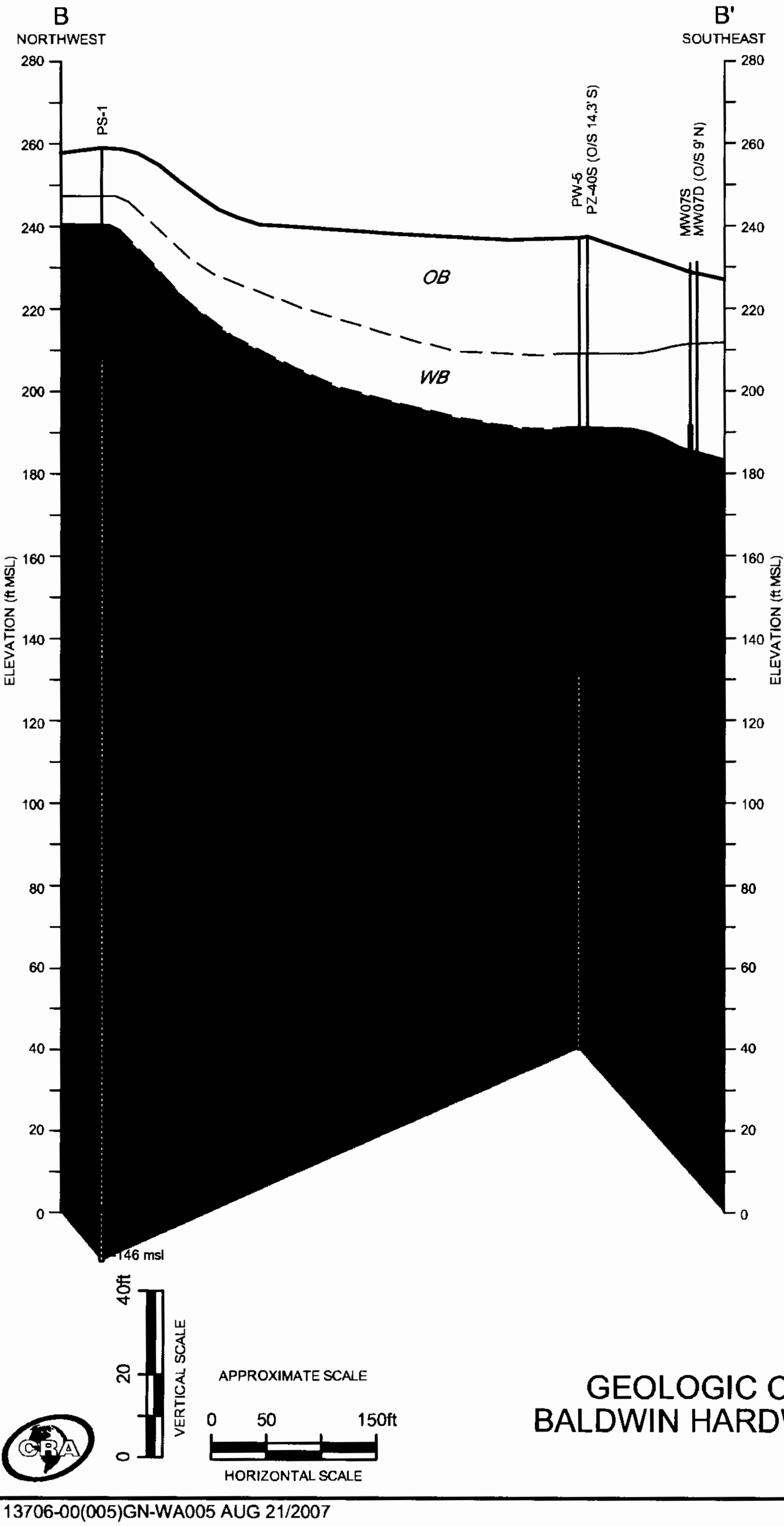


figure 4.2

GEOLOGIC CROSS-SECTION (A-A')
BALDWIN HARDWARE CORPORATION
Reading, Pennsylvania

13706-00(005)GN-WA005 AUG 21/2007



LEGEND

OB OVERBURDEN
WB WEATHERED BEDROCK
BK COMPETENT BEDROCK (BUFFALO SPRINGS FORMATION)

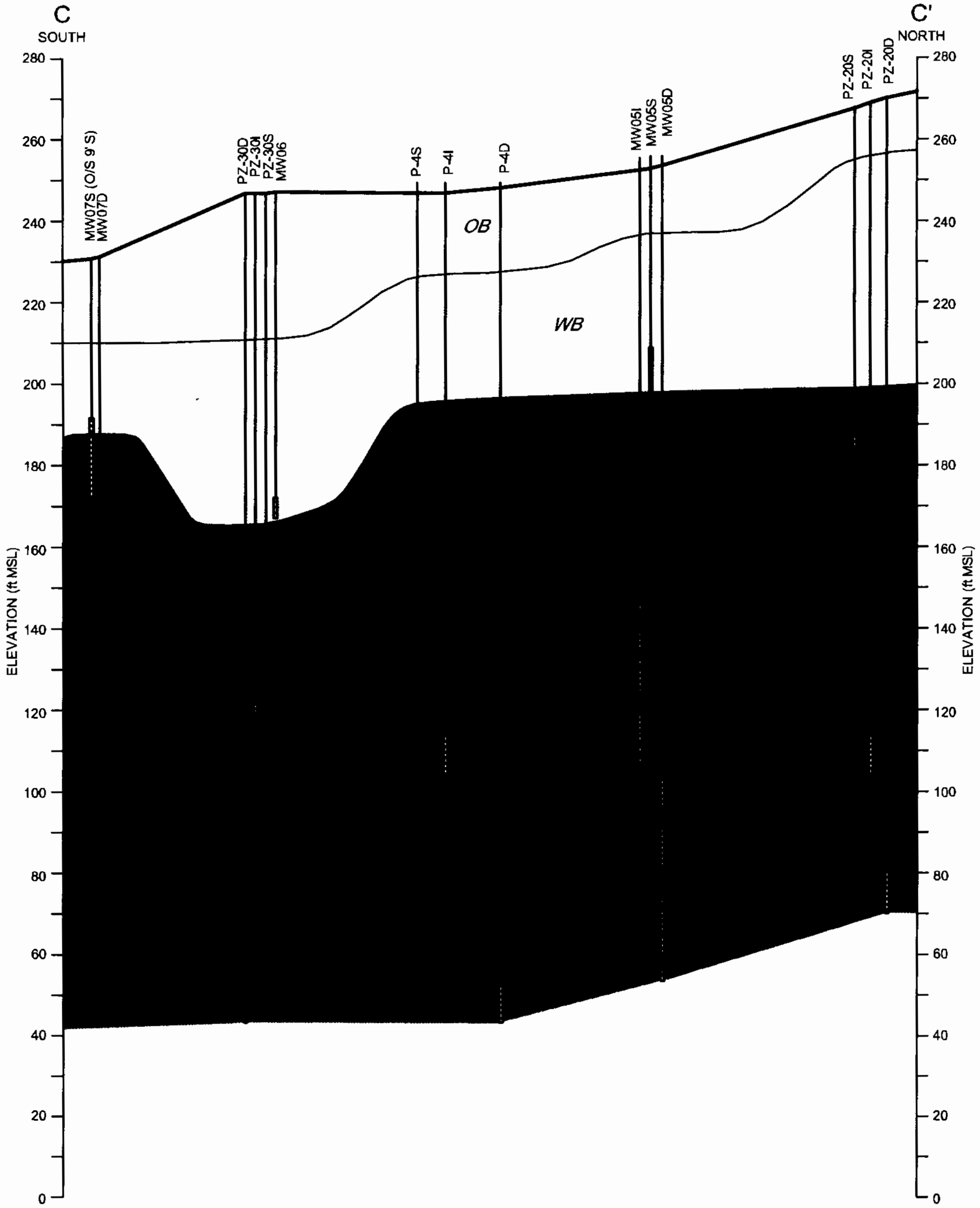
NOTE:

WELLS PZ-40S AND MW07D ARE PROJECTED ONTO THE LINE OF SECTION AND MAY NOT BE REPRESENTED ON THIS FIGURE IN THEIR ACTUAL GEOLOGIC FEATURE.

figure 4.3

GEOLOGIC CROSS-SECTION (B-B')
BALDWIN HARDWARE CORPORATION
Reading, Pennsylvania

13706-00(005)GN-WA005 AUG 21/2007



LEGEND

OB OVERBURDEN
WB WEATHERED BEDROCK
BK COMPETENT BEDROCK
(BUFFALO SPRINGS FORMATION)

NOTE:
WELL MW07S IS PROJECTED ONTO THE LINE OF SECTION AND MAY NOT BE REPRESENTED ON THIS FIGURE IN THEIR ACTUAL GEOLOGIC FEATURE.

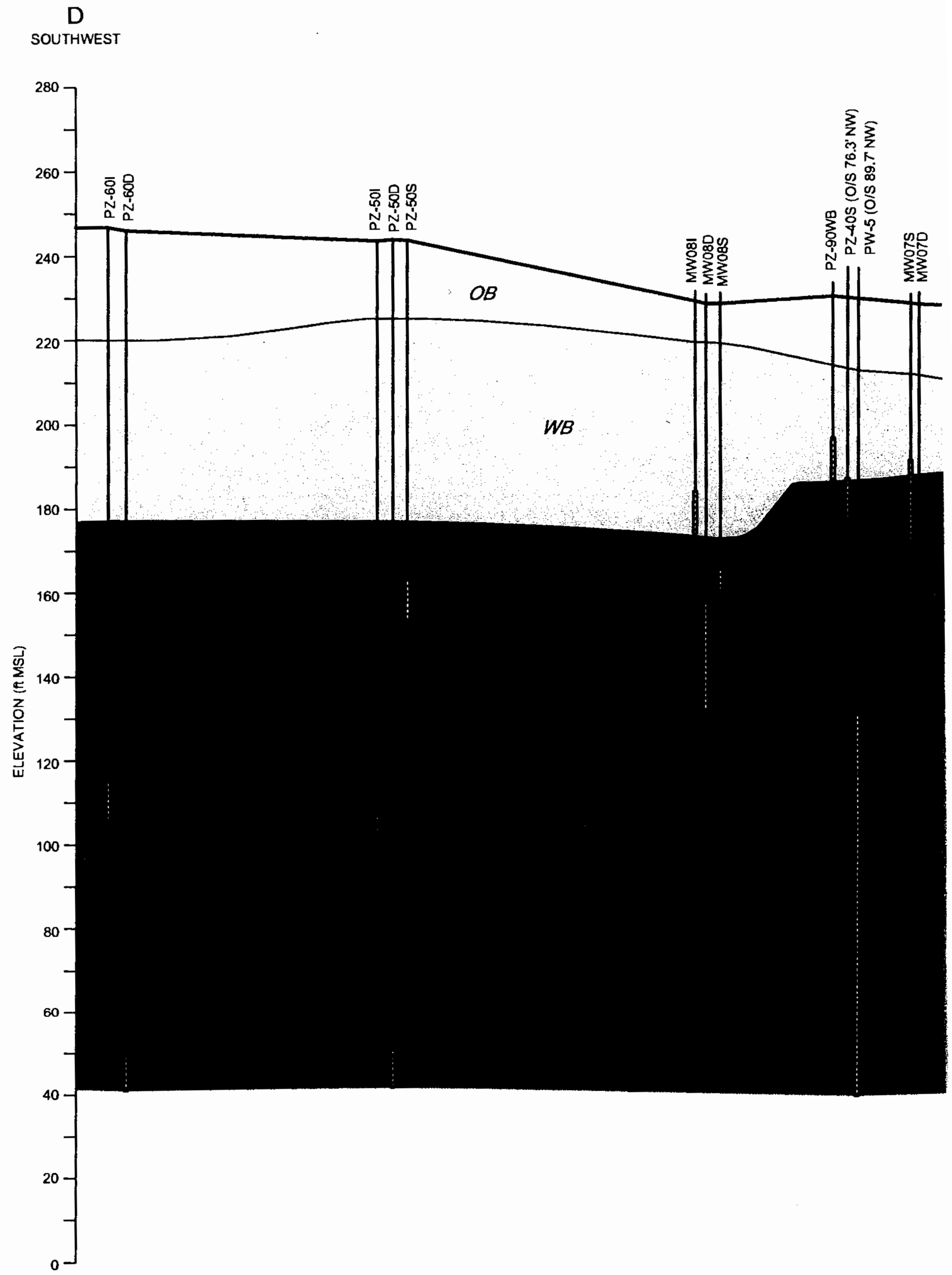
40ft
20
0
VERTICAL SCALE

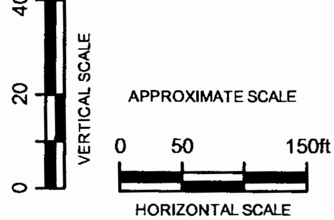
APPROXIMATE SCALE
0 50 150ft
HORIZONTAL SCALE

figure 4.4

GEOLOGIC CROSS-SECTION (C-C')
BALDWIN HARDWARE CORPORATION
Reading, Pennsylvania

13706-00(005)GN-WA005 AUG 21/2007





LEGEND

OB OVERBURDEN
WB WEATHERED BEDROCK
BK COMPETENT BEDROCK
(BUFFALO SPRINGS FORMATION)

NOTE:

WELLS PZ-40S, PW-5, AND MW06 ARE PROJECTED ONTO THE LINE OF SECTION AND MAY NOT BE REPRESENTED ON THIS FIGURE IN THEIR ACTUAL GEOLOGIC FEATURE.

13706-00(005)GN-WA005 AUG 21/2007

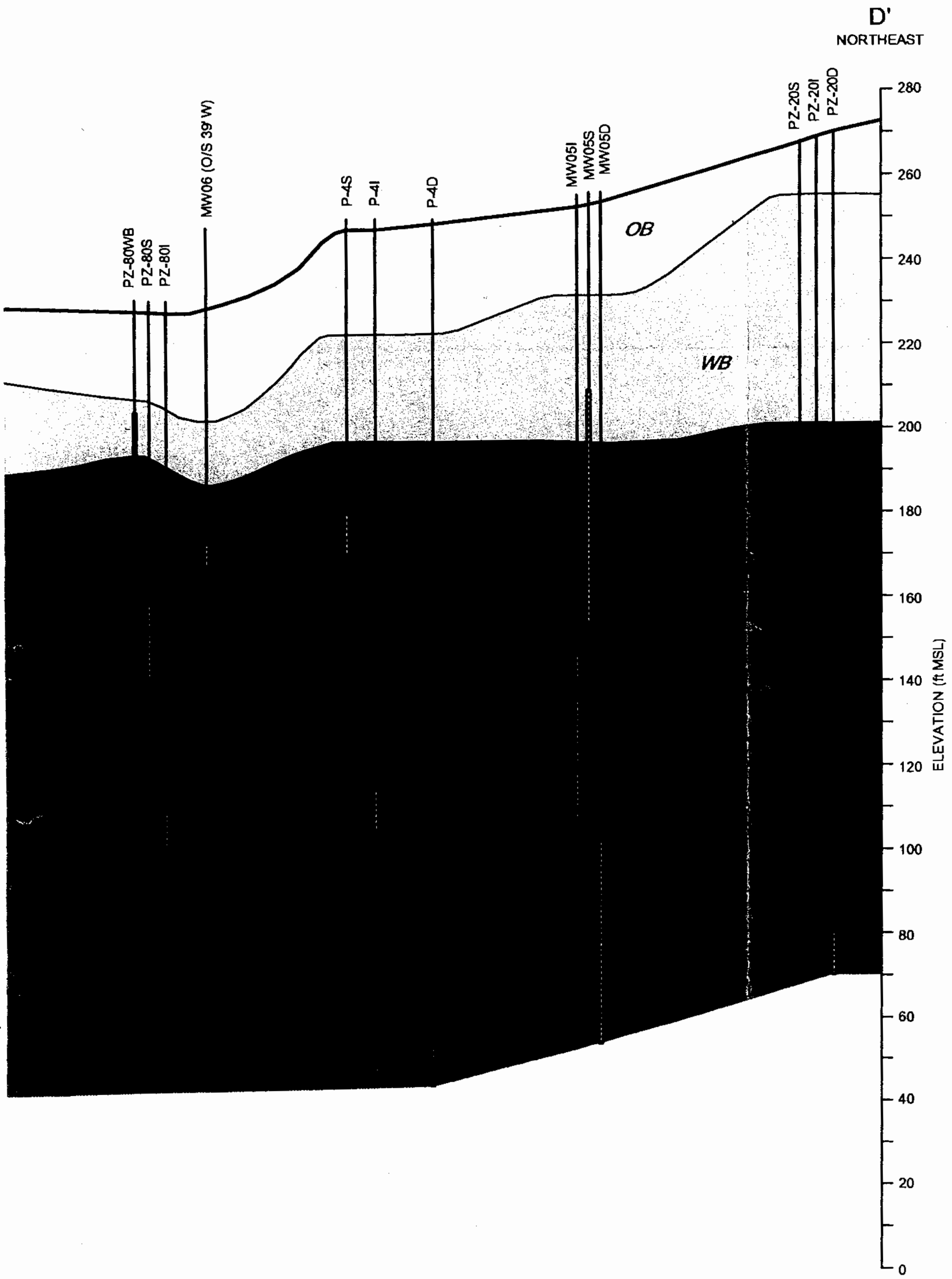
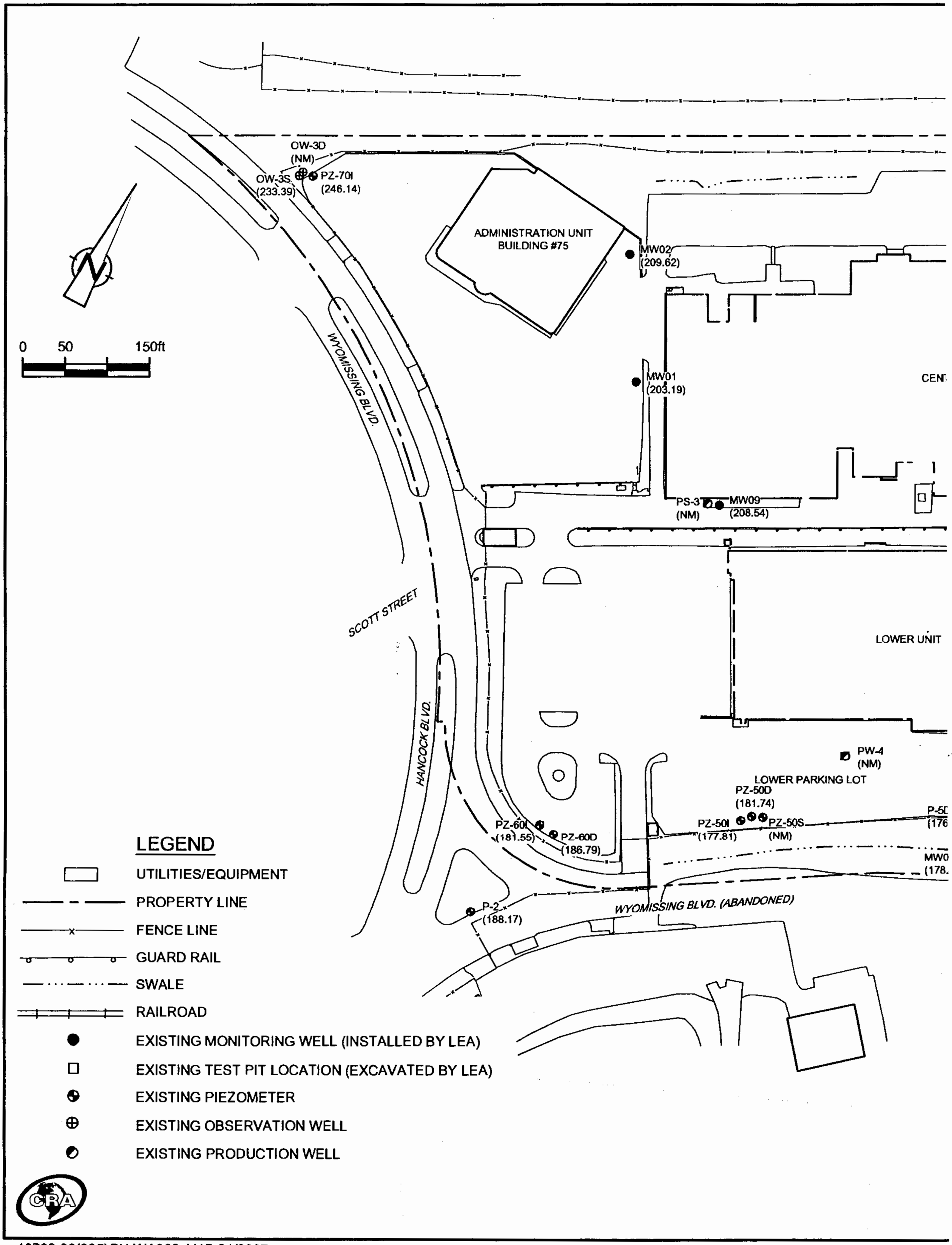


figure 4.5

GEOLOGIC CROSS-SECTION (D-D')
BALDWIN HARDWARE CORPORATION
Reading, Pennsylvania


OW-3D
(NM)
OW-3S
(233.39)
PZ-70I
(246.14)
ADMINISTRATION UNIT
BUILDING #75
MW02
(209.62)
0 50 150ft
WYOMISSING BLVD.
MW01
(203.19)
CEN
PS-3
(NM)
MW09
(208.54)
SCOTT STREET
LOWER UNIT
HANCOCK BLVD.
PW-4
(NM)
LOWER PARKING LOT
PZ-50D
(181.74)
PZ-50I
(177.81)
PZ-50S
(NM)
PZ-60I
(181.55)
PZ-60D
(186.79)
P-2
(188.17)
WYOMISSING BLVD. (ABANDONED)
LEGEND
UTILITIES/EQUIPMENT
PROPERTY LINE
FENCE LINE
GUARD RAIL
SWALE
RAILROAD
EXISTING MONITORING WELL (INSTALLED BY LEA)
EXISTING TEST PIT LOCATION (EXCAVATED BY LEA)
EXISTING PIEZOMETER
EXISTING OBSERVATION WELL
EXISTING PRODUCTION WELL
CRA

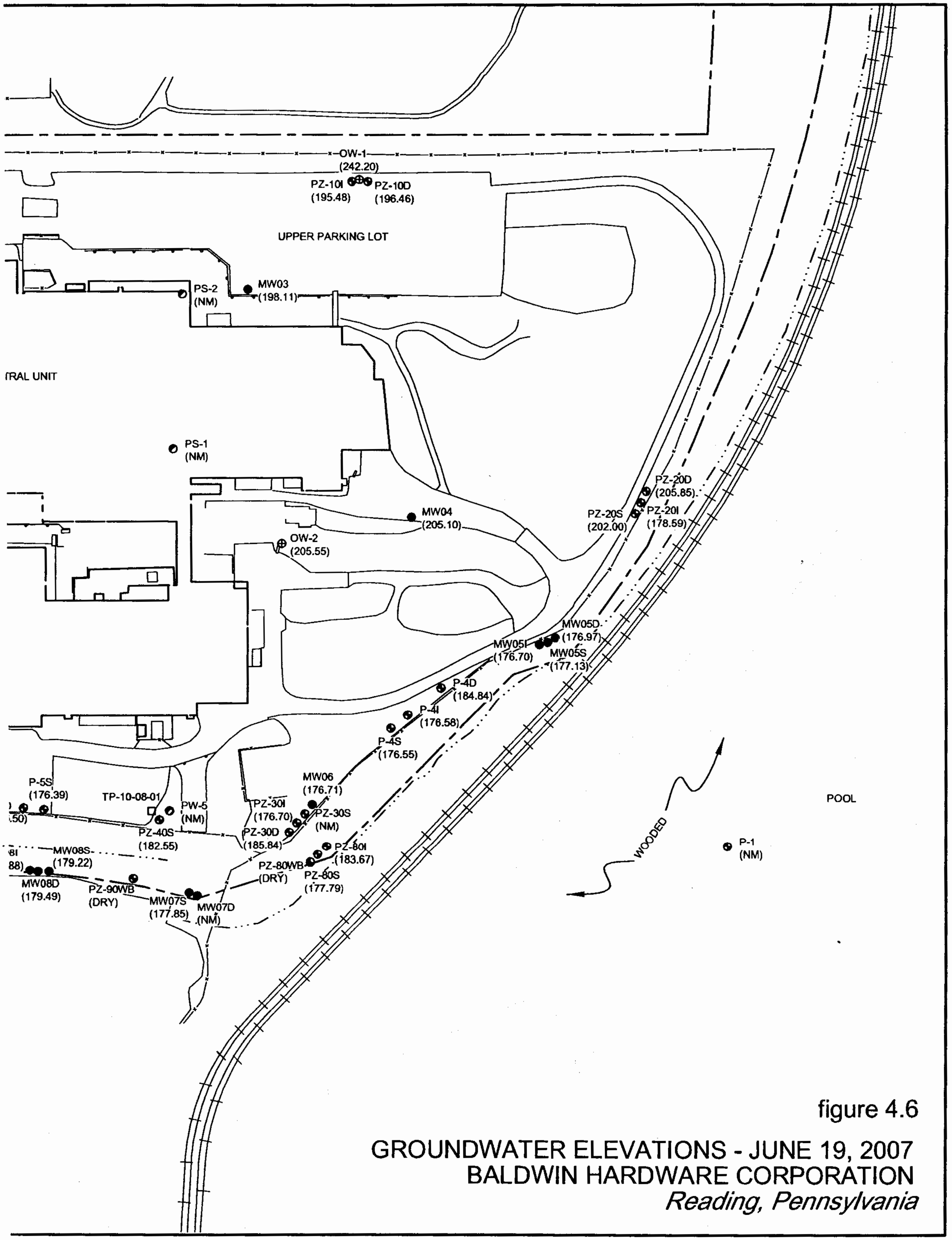
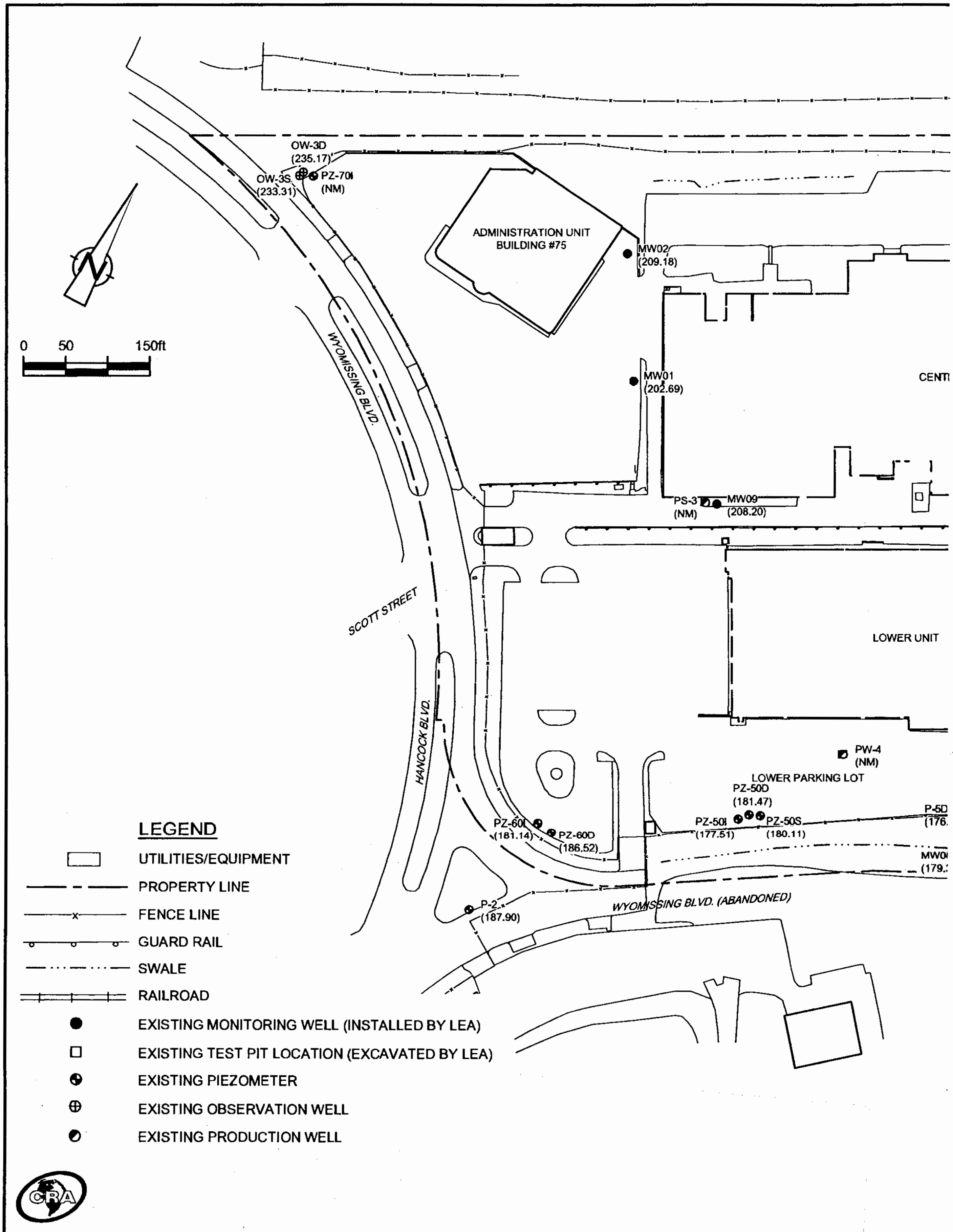


figure 4.6

GROUNDWATER ELEVATIONS - JUNE 19, 2007
BALDWIN HARDWARE CORPORATION
Reading, Pennsylvania



13706-00(005)GN-WA003 AUG 21/2007

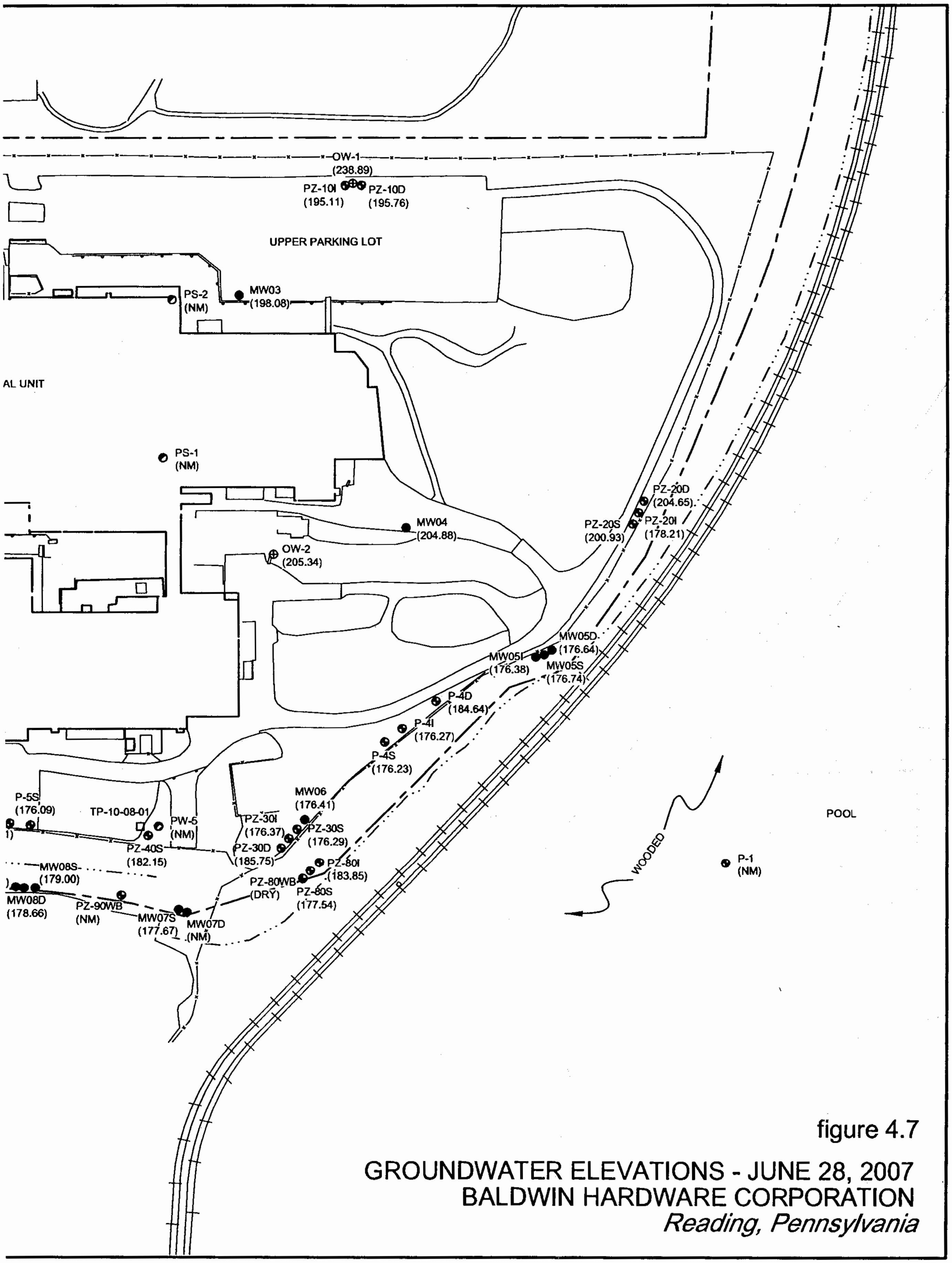
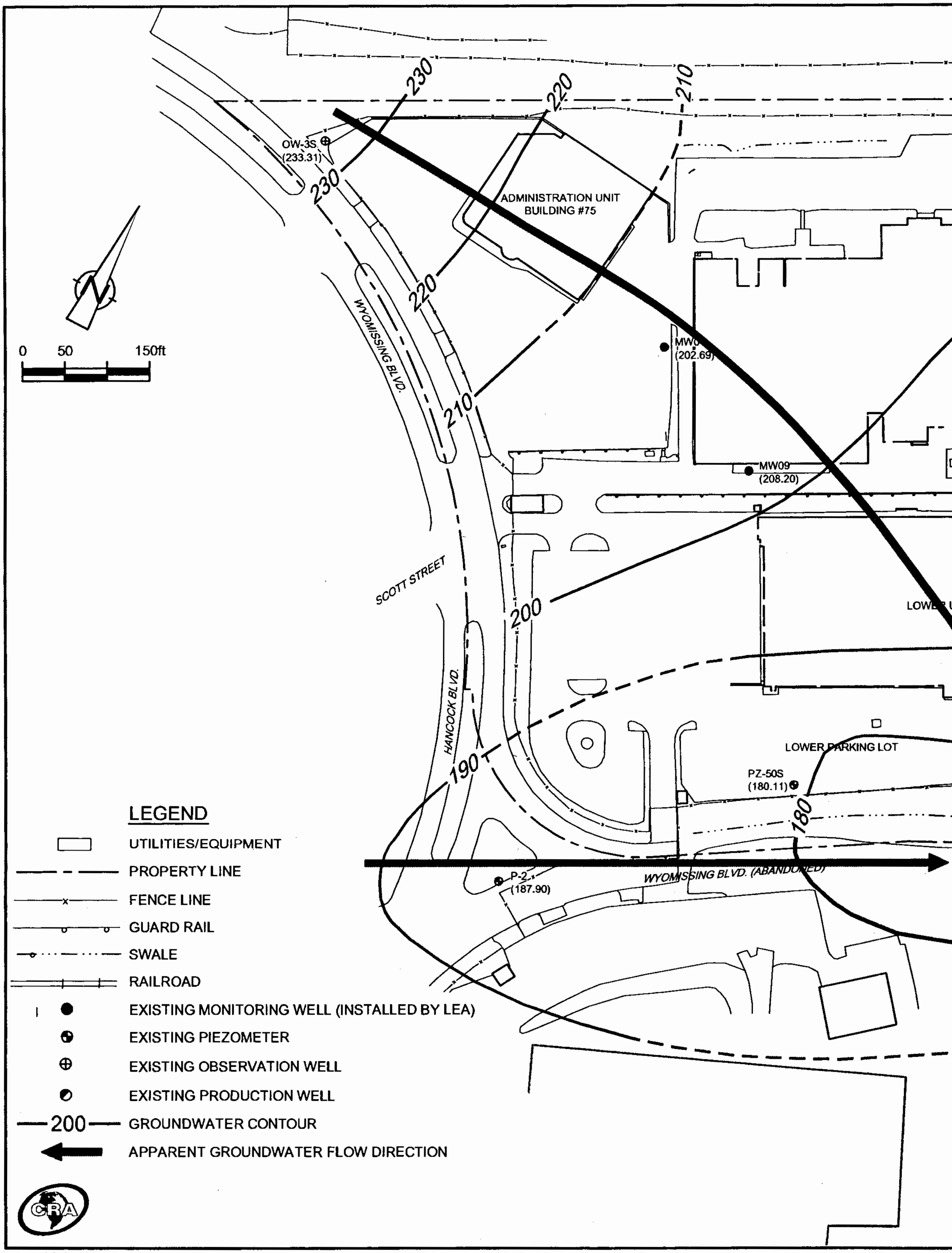


figure 4.7

GROUNDWATER ELEVATIONS - JUNE 28, 2007
BALDWIN HARDWARE CORPORATION
Reading, Pennsylvania



13706-00(005)GN-WA003 AUG 30/2007

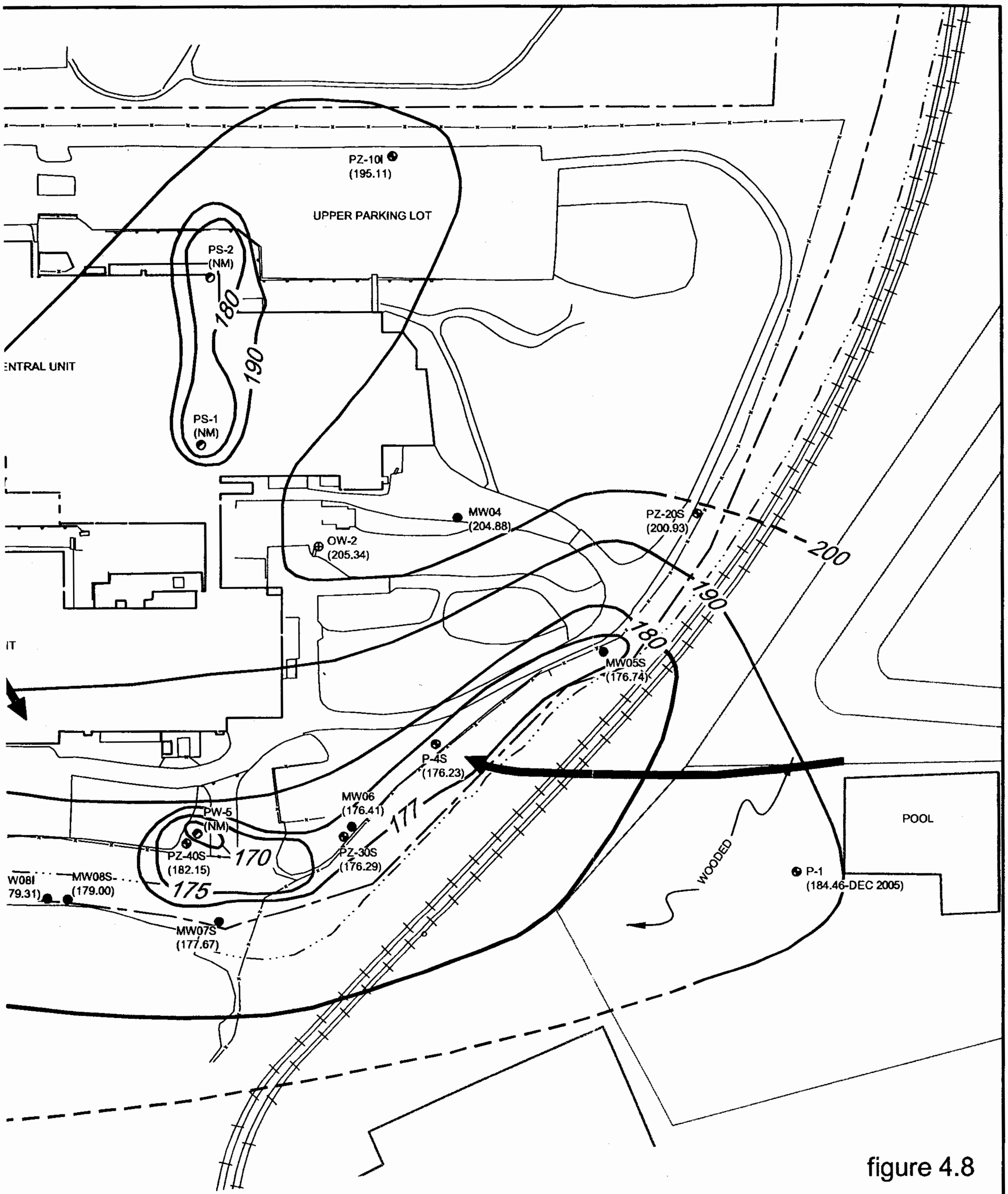


figure 4.8

GROUNDWATER CONTOUR MAP - JUNE 28, 2007
OPEN INTERVAL WITHIN ELEVATIONS FROM 150 FT TO 200 FT AMSL
BALDWIN HARDWARE CORPORATION
Reading, Pennsylvania

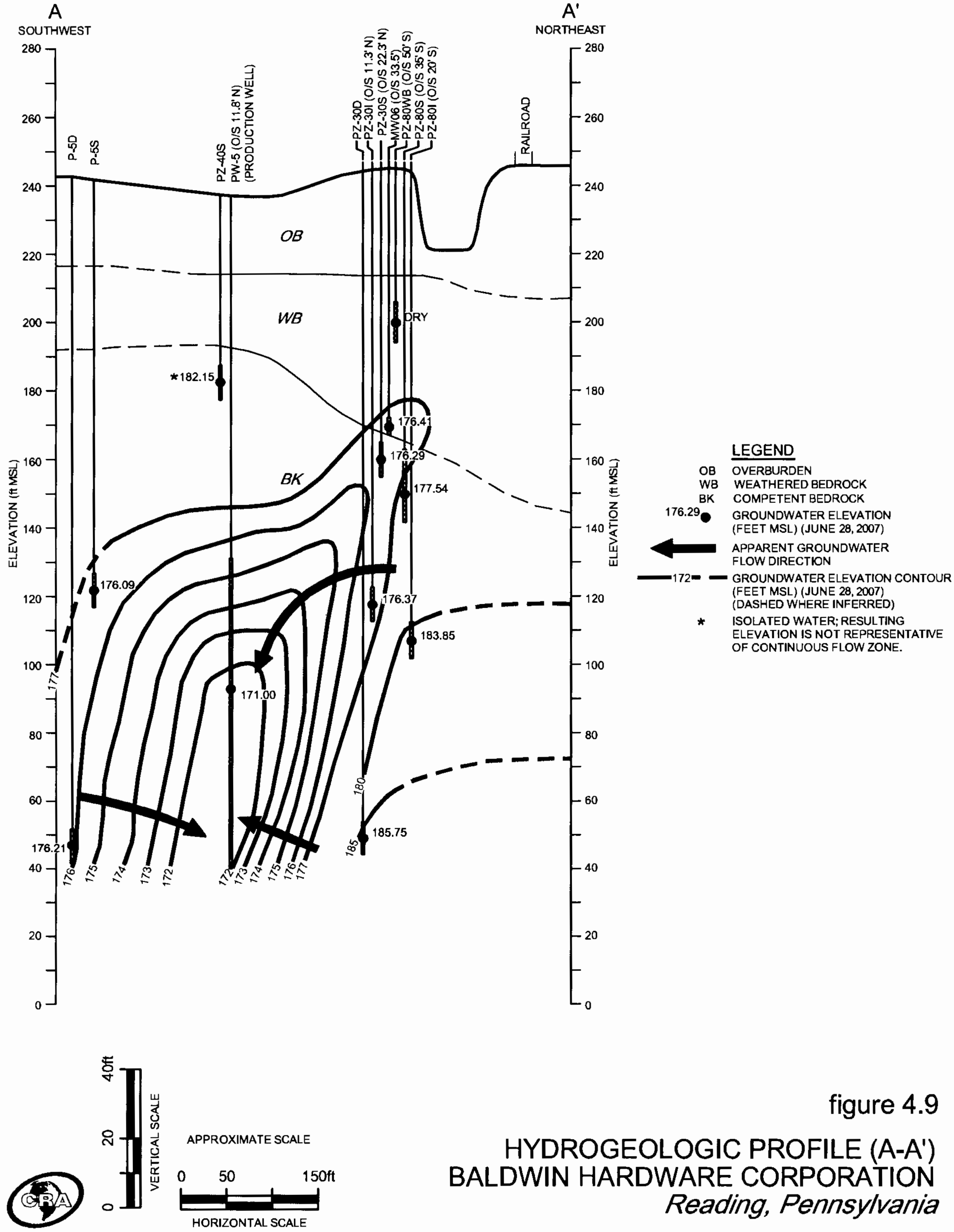


figure 4.9

HYDROGEOLOGIC PROFILE (A-A')
BALDWIN HARDWARE CORPORATION
Reading, Pennsylvania

13706-00(005)GN-WA005 AUG 30/2007

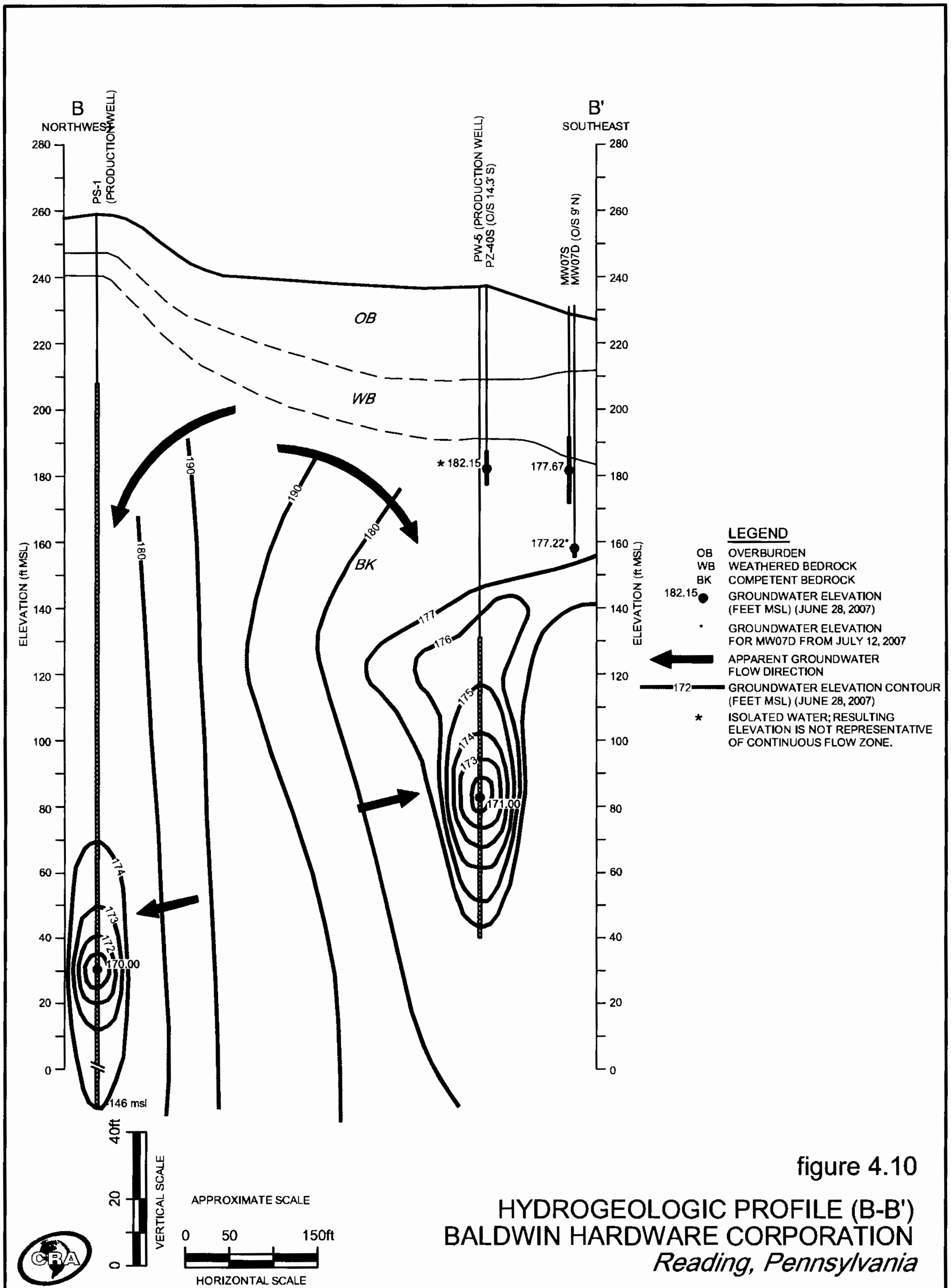


figure 4.10

HYDROGEOLOGIC PROFILE (B-B')
BALDWIN HARDWARE CORPORATION
Reading, Pennsylvania

13706-00(005)GN-WA005 AUG 30/2007

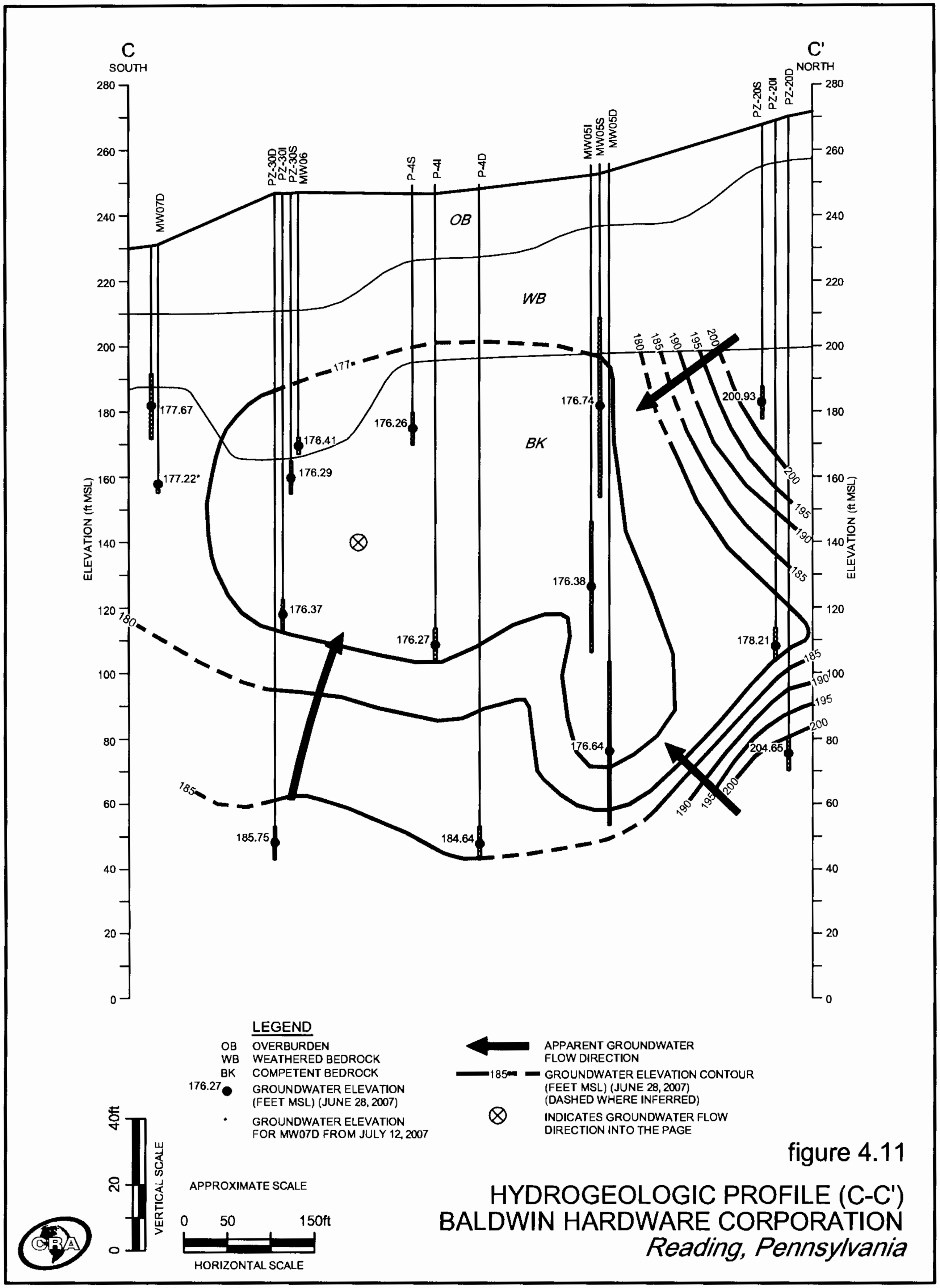
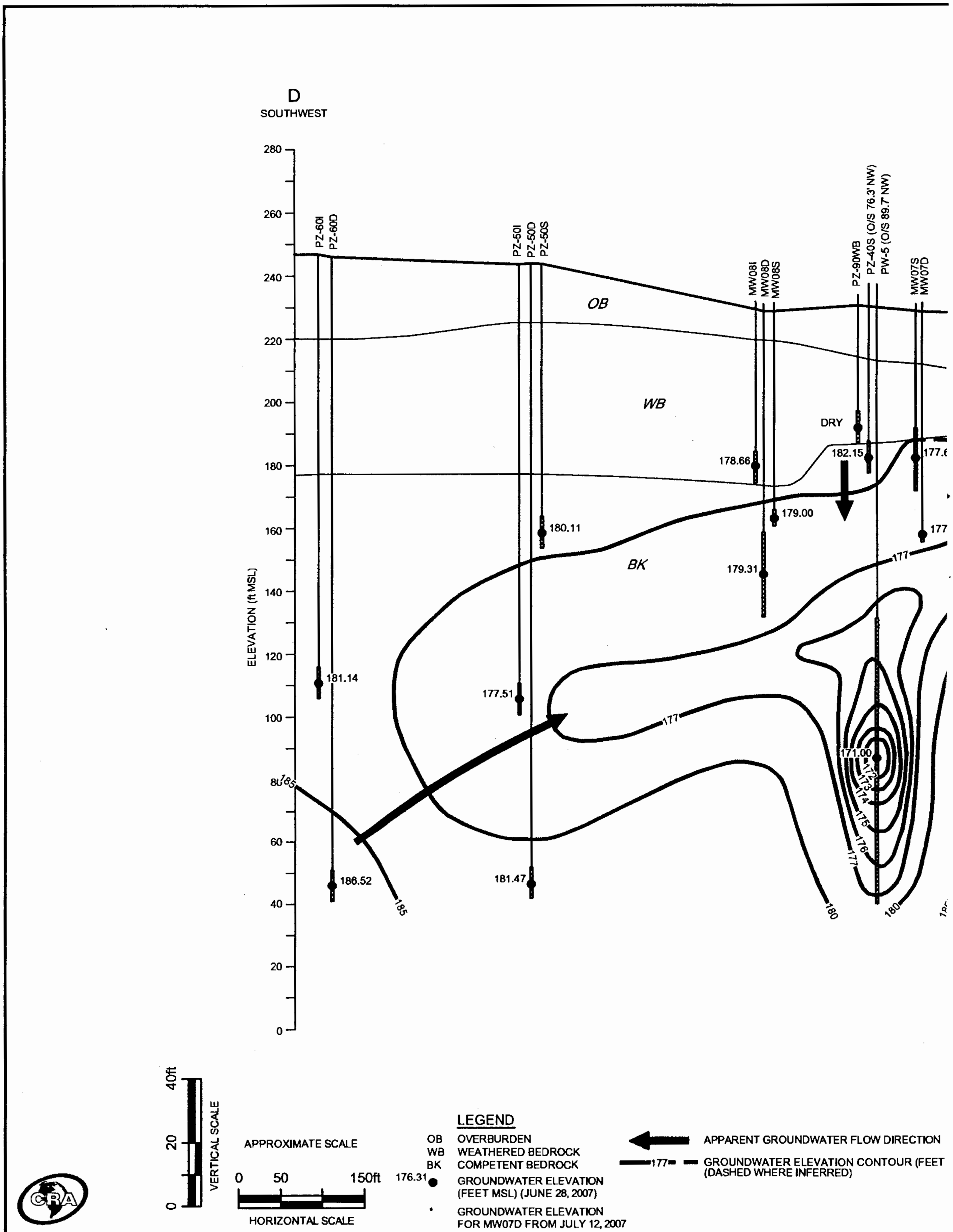


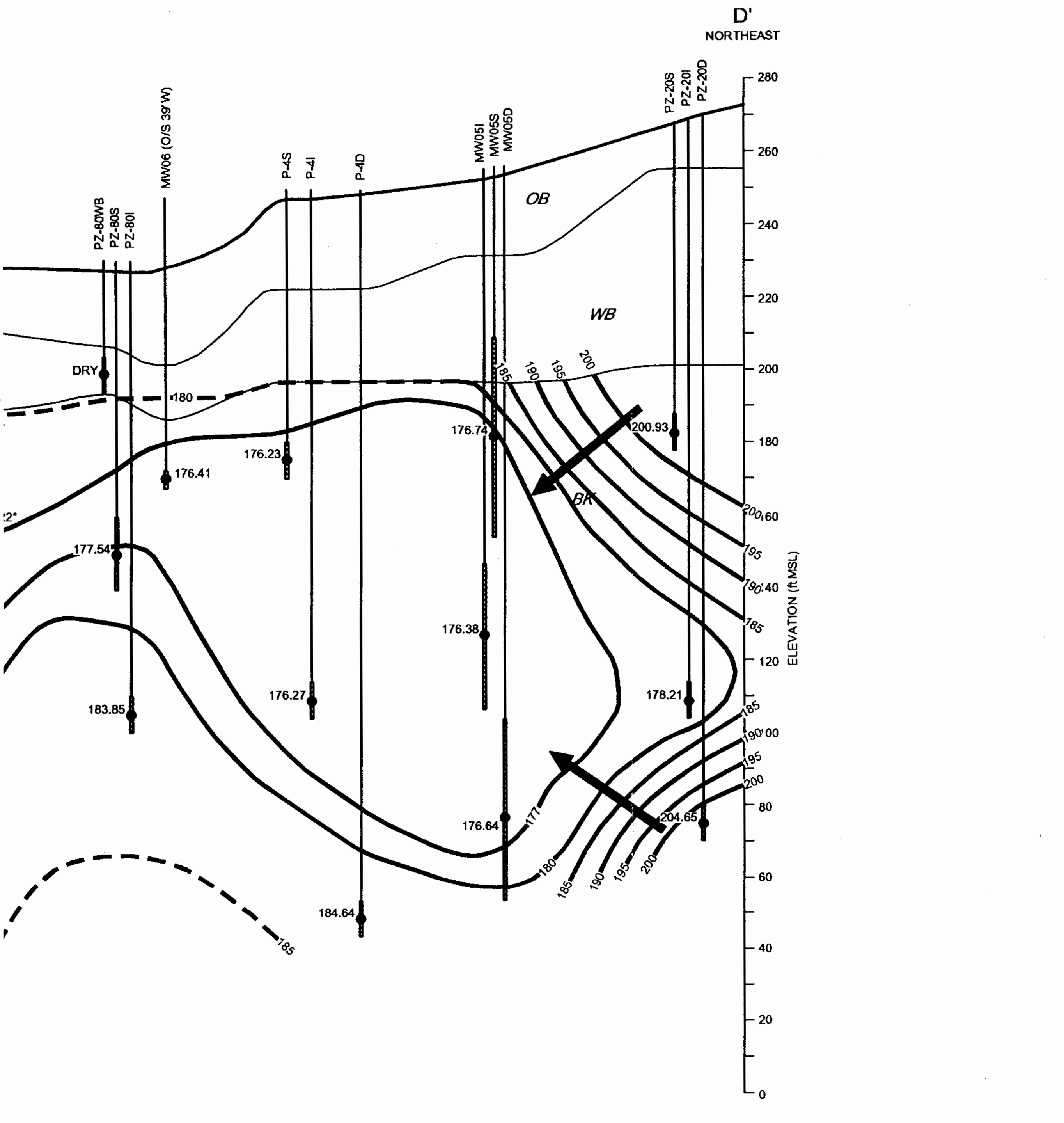
figure 4.11

HYDROGEOLOGIC PROFILE (C-C')
BALDWIN HARDWARE CORPORATION
Reading, Pennsylvania

13706-00(005)GN-WA005 AUG 30/2007



13706-00(005)GN-WA005 AUG 30/2007



SL) (JUNE 28, 2007)

figure 4.12

HYDROGEOLOGIC PROFILE (D-D')
BALDWIN HARDWARE CORPORATION
Reading, Pennsylvania

Figure 4.13
Transducer Data for Monitoring Wells, Schuylkill River and Precipitation - July 3 to 31, 2007
Baldwin Hardware, Reading, Pennsylvania

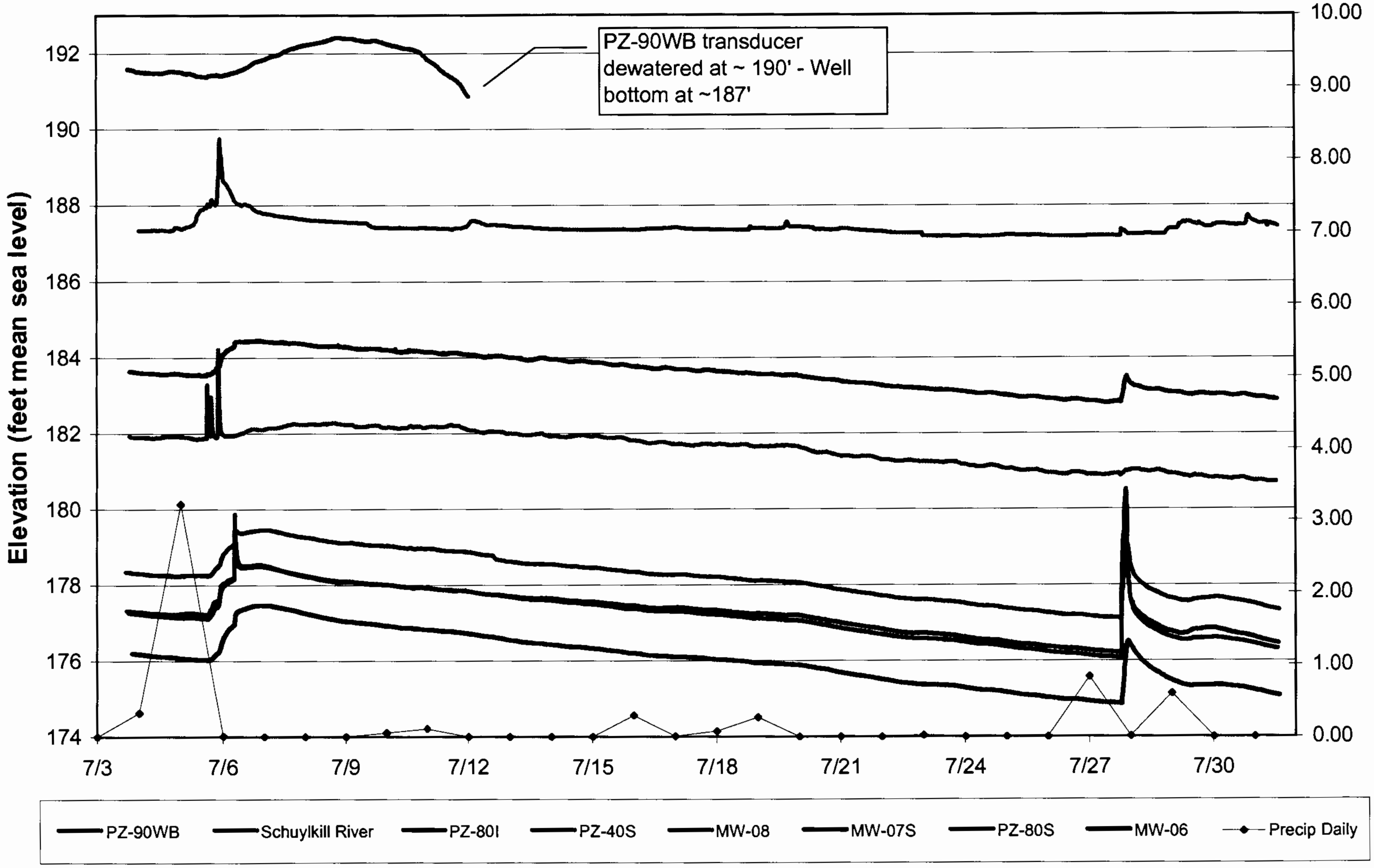


Figure 4.14
Tranducer Data for Select Wells During System Shutdown - July 5 and 6, 2007
Baldwin Hardware, Reading, Pennsylvania

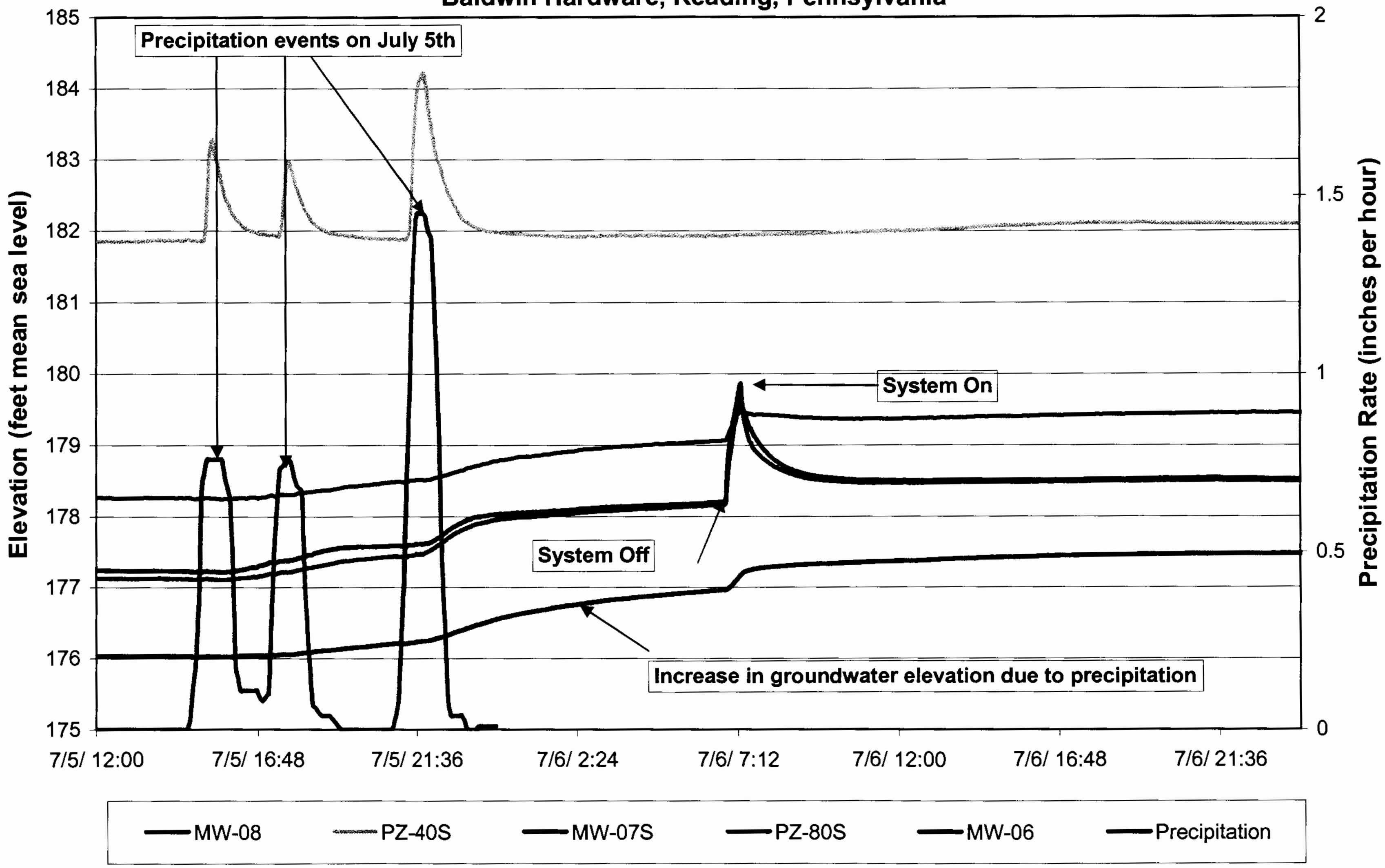


Figure 4.15
Tranducer Data for PZ-40S, PZ-80I, and Precipitation - July 5 and 6, 2007
Baldwin Hardware, Reading, Pennsylvania

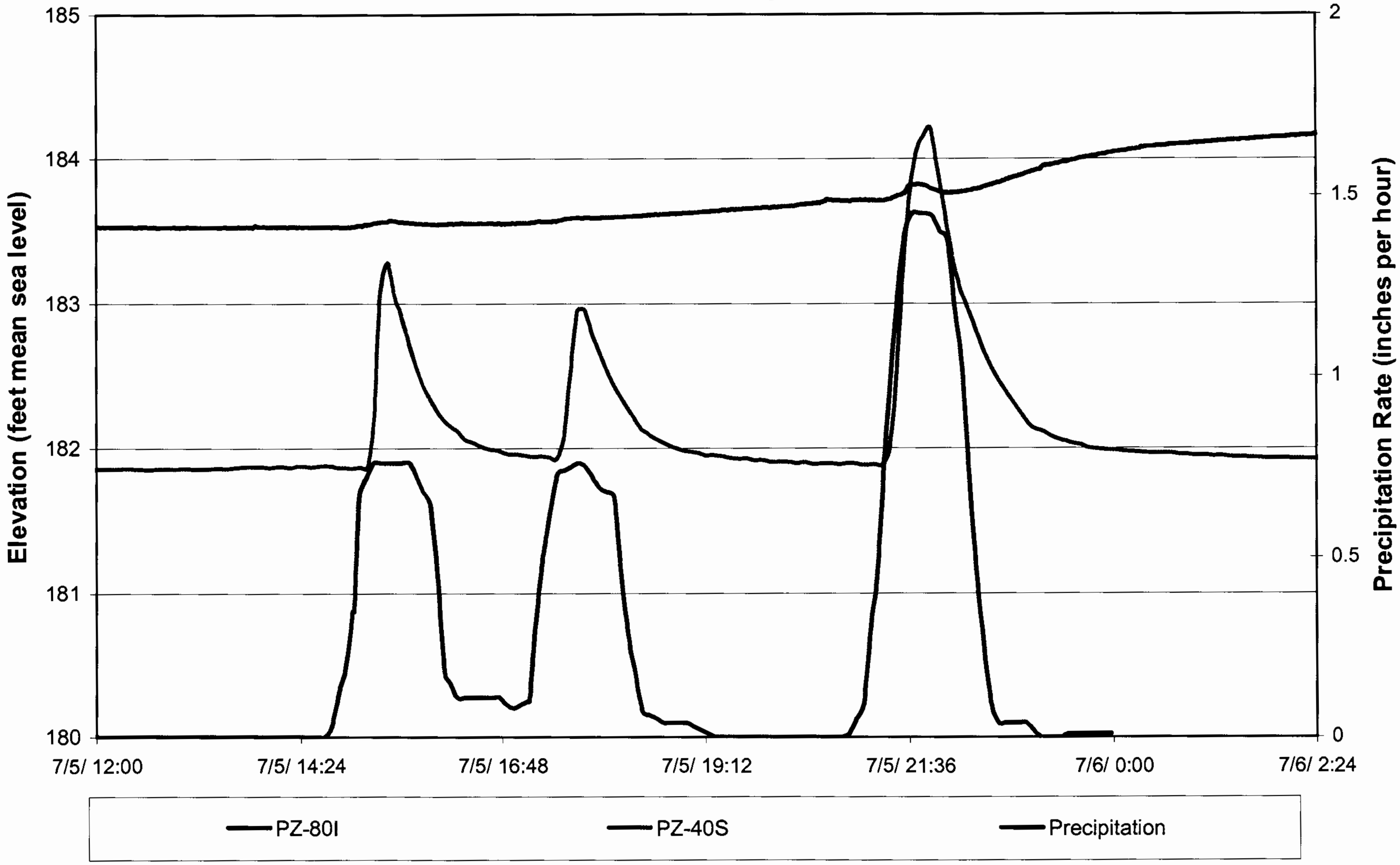


Figure 4.16
Transducer Data for PZ-40S, MW-08, MW-07S, PZ-80S, and MW-06 - July 27-31, 2007
Baldwin Hardware, Reading, Pennsylvania

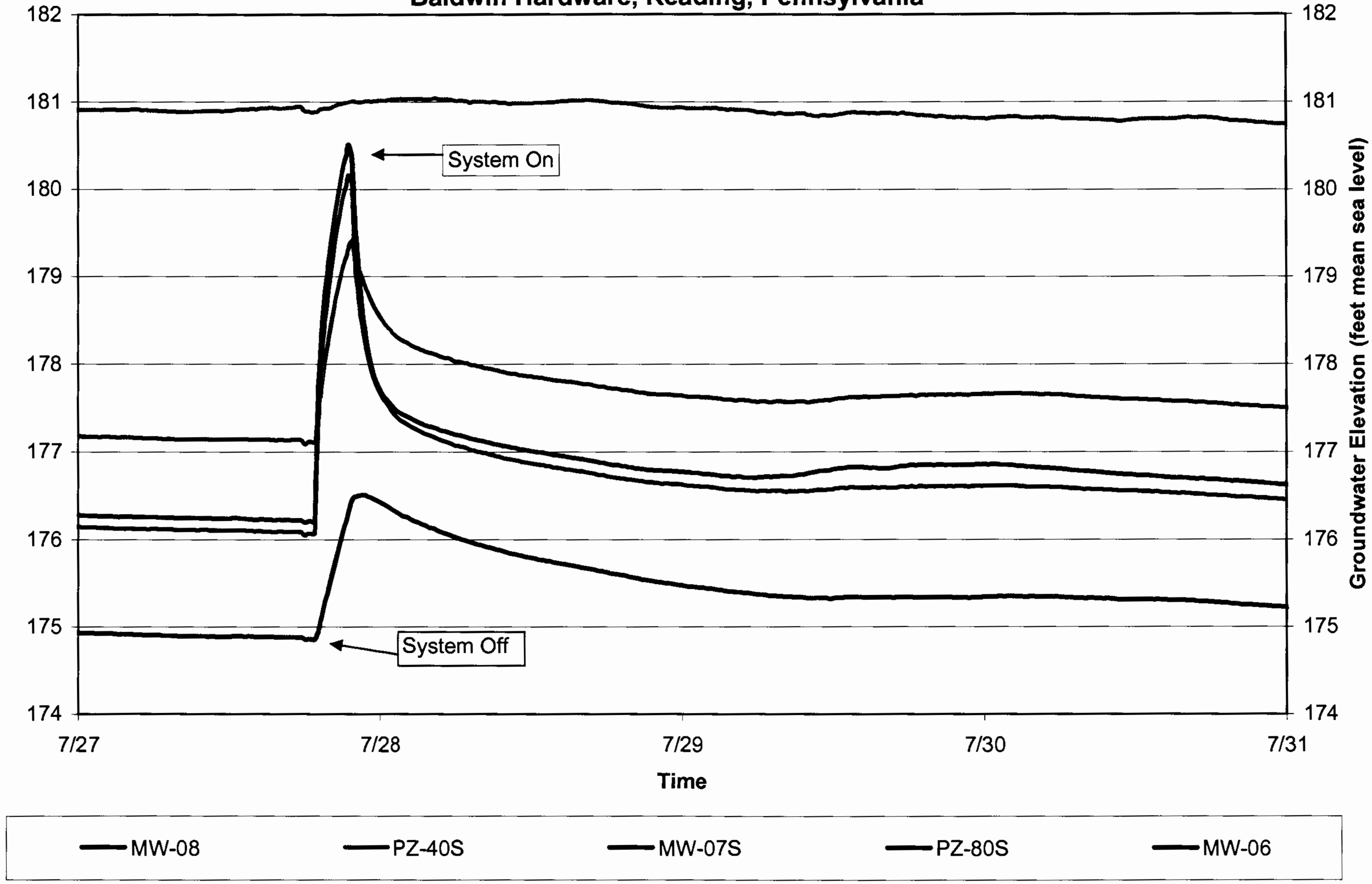


Table 3.1
Well and Piezometer Construction Details
Baldwin Hardware
Reading, Pennsylvania

Well Identification	Ground Surface ft amsl	Outer Casing Elevation ft amsl	Inner Casing Elevation ft amsl	Top Screen ft bgs	Top Screen ft amsl	Bottom Screen ft bgs	Bottom Screen ft amsl	Completion Type	Diameter inches
MW-01	267.56	267.35	267.05	27	240.6	107	160.6	screen	4
MW-02	272.81	272.74	272.24						
MW-03	295.90	295.92	295.54	50	245.9	100	195.9	screen	4
MW-04	266.50	266.48	266.14	50	216.5	100	166.5	screen	4
MW-05D	253.48	255.81	255.32	150	103.5	200	53.5	screen	2
MW-05I	252.29	255.22	254.78	106	146.3	146	106.3	screen	2
MW-05S	252.74	255.65	255.21	44	208.7	99	153.7	screen	2
MW-06	245.00	247.11	246.51	73	172.0	78	167.0	screen	4
MW-07D	228.30	231.17	--	72	156.3	73	155.3	open hole	6
MW-07S	228.60	230.79	230.18	37	191.6	57	171.6	screen	2
MW-08	229.24	231.72	230.98	45	184.2	55	174.2	screen	1.5
MW-08D	228.62	230.94	--	70	158.6	97	131.6	open hole	6
MW-08S	228.67	231.28	230.95	63	165.7	68	160.7	screen	2
MW-09	263.10	262.75	262.80	30	233.1	100	163.1	screen	4
OW-1	299.21	302.92	302.46	53	246.2	79	220.2	screen	2
OW-2	252.54	262.13	262.04	62	190.5	100	152.5	screen	2
OW-3D	277.38	279.54	279.72	190	87.4	200	77.4	screen	2
OW-3S	277.34	279.54	279.64	79	198.8	89	188.8	screen	2
P-1	217.31	217.60	217.19	54	163.8	64	153.8	screen	2
P-2	243.67	243.81	243.37	81	163.2	91	153.2	screen	2
P-3D	202.52	202.54	202.08	190	12.9	200	2.9	screen	2
P-3I	202.42	202.44	202.03	87	115.4	97	105.4	screen	2
P-3S	202.37	202.41	201.88	38	164.9	48	154.9	screen	2
P-4D	248.12	249.33	249.44	195	53.6	205	43.6	screen	2
P-4I	246.74	249.34	249.43	133	114.0	143	104.0	screen	2
P-4S	246.76	249.26	249.37	67	179.8	77	169.8	screen	2
P-5D	242.60	242.76	242.42	191	51.6	201	41.6	screen	2
P-5S	241.70	241.86	241.56	115	126.7	125	116.7	screen	2
PS-1	259.00	--	--	51	208.0	405	-146.0	open hole	8
PS-2	258.00	--	--	68	190.0	380	-122.0	open hole	8
PS-3	252.00	--	--	101	151.0	559	-307.0	open hole	8
PW-4	237.00	--	--	99	138.0	297	-60.0	open hole	8
PW-5	237.00	--	--	106	131.0	197	40.0	screen	8
PZ-10D	299.36	299.39	298.74	251	48.4	261	38.4	screen	1
PZ-10I	298.93	299.04	298.68	130	168.9	140	158.9	screen	1

Table 3.1
Well and Piezometer Construction Details
Baldwin Hardware
Reading, Pennsylvania

Well Identification	Ground Surface ft amsl	Outer Casing Elevation ft amsl	Inner Casing Elevation ft amsl	Top Screen ft bgs	Top Screen ft amsl	Bottom Screen ft bgs	Bottom Screen ft amsl	Completion Type	Diameter inches
PZ-20D	270.12	270.20	269.47	190	80.1	200	70.1	screen	1
PZ-20I	268.83	268.98	268.46	155	113.8	165	103.8	screen	1
PZ-20S	267.59	267.81	267.46	80	187.6	90	177.6	screen	1
PZ-30D	244.19	245.49	244.98	190	54.2	200	44.2	screen	1
PZ-30I	244.58	246.81	246.61	122	122.6	132	112.6	screen	1
PZ-30S	244.77	246.81	246.02	80	164.8	90	154.8	screen	1
PZ-40S	237.24	237.24	236.48	51	186.2	61	176.2	screen	1
PZ-50D	243.88	243.82	243.30	192	51.9	202	41.9	screen	1
PZ-50I	243.62	243.68	243.26	133	110.6	143	100.6	screen	1
PZ-50S	243.76	243.78	242.95	80	163.8	90	153.8	screen	1
PZ-60D	245.92	245.86	245.20	195	50.9	205	40.9	screen	1
PZ-60I	246.80	246.73	245.90	131	115.8	141	105.8	screen	1
PZ-70I	275.98	276.13	275.71	154	122.0	164	112.0	screen	1
PZ-80I	226.88	229.77	228.77	117	109.9	127	99.9	screen	2
PZ-80S	227.18	229.80	229.35	68	159.2	88	139.2	screen	2
PZ-80WB	227.32	230.07	229.89	24	203.3	34	193.3	screen	2
PZ-90WB	230.35	233.64	233.40	33.5	196.9	43.5	186.9	screen	2

Notes:
1. ft - feet
2. amsl - above mean sea level
3. bgs - below ground surface

Table 3.2
Groundwater Elevations
Baldwin Hardware, Reading, Pennsylvania

Well Identification	Ground Surface	Outer Casing Elevation	Inner Casing Elevation	Groundwater Elevation	Depth-to-Water Level	Groundwater Elevation	Depth-to-Water Level	Groundwater Elevation
	ft amsl	ft amsl	ft amsl	November 27, 2005	June 19, 2007	June 19, 2007	June 28, 2007	June 28, 2007
MW-01	267.56	267.35	267.05	213.97	63.86	203.19	64.36	202.69
MW-02	272.81	272.74	272.24		62.62	209.62	63.06	209.18
MW-03	295.90	295.92	295.54	232.61	97.43	198.11	97.46	198.08
MW-04	266.50	266.48	266.14	205.16	61.04	205.10	61.26	204.88
MW-05D	253.48	255.81	255.32	173.90	78.35	176.97	78.68	176.64
MW-05I	252.29	255.22	254.78	173.55	78.08	176.70	78.40	176.38
MW-05S	252.74	255.65	255.21	174.54	78.08	177.13	78.47	176.74
MW-06	245.00	247.11	246.51	173.55	69.80	176.71	70.10	176.41
MW-07D	228.30	231.17	--	174.24	NM	NM	NM	NM
MW-07S	228.60	230.79	230.18	174.92	52.33	177.85	52.51	177.67
MW-08	229.24	231.72	230.98		52.10	178.88	52.32	178.66
MW-08D	228.62	230.94	--	176.84	51.45	179.49	51.63	179.31
MW-08S	228.67	231.28	230.95	176.44	51.73	179.22	51.95	179.00
MW-09	263.10	262.75	262.80	214.86	54.26	208.54	54.60	208.20
OW-1	299.21	302.92	302.46	236.40	60.26	242.20	63.57	238.89
OW-2	252.54	262.13	262.04	206.51	56.49	205.55	56.70	205.34
OW-3D	277.38	279.54	279.72	237.20	NM	NM	44.55	235.17
OW-3S	277.34	279.54	279.64	233.12	46.25	233.39	46.33	233.31
P-1	217.31	217.60	217.19	184.46	NM	NM	NM	NM
P-2	243.67	243.81	243.37	--	55.20	188.17	55.47	187.90
P-3D	202.52	202.54	202.08	190.00	12.00	190.08	NM	NM
P-3I	202.42	202.44	202.03	187.31	15.24	186.79	NM	NM
P-3S	202.37	202.41	201.88	173.13	12.09	189.79	NM	NM
P-4D	248.12	249.33	249.44	184.56	64.60	184.84	64.80	184.64
P-4I	246.74	249.34	249.43	173.50	72.85	176.58	73.16	176.27
P-4S	246.76	249.26	249.37	173.35	72.82	176.55	73.14	176.23
P-5D	242.60	242.76	242.42	173.04	65.92	176.50	66.21	176.21
P-5S	241.70	241.86	241.56	173.13	65.17	176.39	65.47	176.09
PS-1	259.00	--	--	--	NM	NM	NM	NM
PS-2	258.00	--	--	--	NM	NM	NM	NM
PS-3	252.00	--	--	--	NM	NM	NM	NM
PW-4	237.00	--	--	--	NM	NM	NM	NM
PW-5	237.00	--	--	--	NM	NM	NM	NM
PZ-10D	299.36	299.39	298.74	229.20	102.28	196.46	102.98	195.76
PZ-10I	298.93	299.04	298.68	225.09	103.20	195.48	103.57	195.11
PZ-20D	270.12	270.20	269.47	178.16	63.62	205.85	64.82	204.65
PZ-20I	268.83	268.98	268.46	204.32	89.87	178.59	90.25	178.21
PZ-20S	267.59	267.81	267.46	209.77	65.46	202.00	66.53	200.93
PZ-30D	244.19	245.49	244.98	184.46	59.14	185.84	59.23	185.75
PZ-30I	244.58	246.81	246.61	173.53	69.91	176.70	70.24	176.37
PZ-30S	244.77	246.81	246.02	173.47	NM	NM	69.73	176.29
PZ-40S	237.24	237.24	236.48	176.40	53.93	182.55	54.33	182.15
PZ-50D	243.88	243.82	243.30	179.10	61.56	181.74	61.83	181.47
PZ-50I	243.62	243.68	243.26	174.60	65.45	177.81	65.75	177.51
PZ-50S	243.76	243.78	242.95	175.55	NM	NM	62.84	180.11
PZ-60D	245.92	245.86	245.20	184.94	58.41	186.79	58.68	186.52
PZ-60I	246.80	246.73	245.90	178.16	64.35	181.55	64.76	181.14
PZ-70I	275.98	276.13	275.71	--	29.57	246.14	NM	NM
PZ-80I	226.88	229.77	228.77	NA	45.10	183.67	44.92	183.85
PZ-80S	227.18	229.80	229.35	NA	51.56	177.79	51.81	177.54
PZ-80WB	227.32	230.07	229.89	DRY	DRY	DRY	DRY	DRY
PZ-90WB	230.35	233.64	233.40	NA	DRY	DRY	NM	NM

Notes:
1. ft - feet
2. amsl - above mean sea level.
3. DTW - Depth-to-Water level.
4. NM - Not measured.